Boeing
B737-600/700/800/900

RoU

ATA Several, from 00..80
A3 Schematics

EASA Part-66

B1/B2

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Revision Identification:

- The date given in the column "Revision" on the face of this cover is binding for the complete Training Manual.
- Dates and author's ID, which may be given at the base of the individual pages, are for information about the latest revision of that page(s) only.
- The LTT production process ensures that the Training Manual contains a complete set of all necessary pages in the latest finalized revision.

Reference to Figure 1 Air Conditioning Basic Schematic (Cont.)

8 Reheater

The reheater increases the temperature of the air in the air conditioning pack before it enters the turbine of the air cycle machine. This increases the efficiency of the turbine.

9 Air Conditioning Distribution

The two air conditioning packs supply the main distribution manifold with conditioned air. The main distribution manifold supplies air to the passenger compartment through riser ducts and an overhead distribution manifold.

10 Pack/Zone Controller

Two identical and interchangeable controllers control the cooling pack discharge temperature and forms a three zone temperature control system.

11 Air Conditioning Accessory Unit

The ACAU is the interface of the airplane‘s operational logic and the air systems. Protection of the pack is provided by 3 thermal switches.

- **200°C** (compressor outlet); or **100°C** (turbine inlet) or **120°C** (pack discharge)

  the pack valve closes.

  If the pack valve is closed, the temperature control valve closes (pack valve closed relay).

12 Recirculation Fan

A recirculation system is installed to provide ventilation while minimizing bleed air requirements. An electrically blower draws cabin air through filters and discharges into the mixing and distribution manifold.

13 Trim Air Press Regulating Valve

The trim air pressure regulating and shutoff valve controls the flow and pressure of air to the zone trim air modulating valves. The solenoid valve is energized open when the TRIM AIR switch on the P5 overhead panel is positioned to the ON. The servo regulator regulates the trim air to (+) 4.0 psi above the actual cabin pressure.

14 Trim Air Modulating Valve (3)

The trim air modulating valves port hot bleed air into the control cabin and passenger cabin FWD/AFT zone ducts to meet zone temperature requirements.

15 Door Area Heaters

The door area heaters supply added heat to prevent cold zones around the doors.

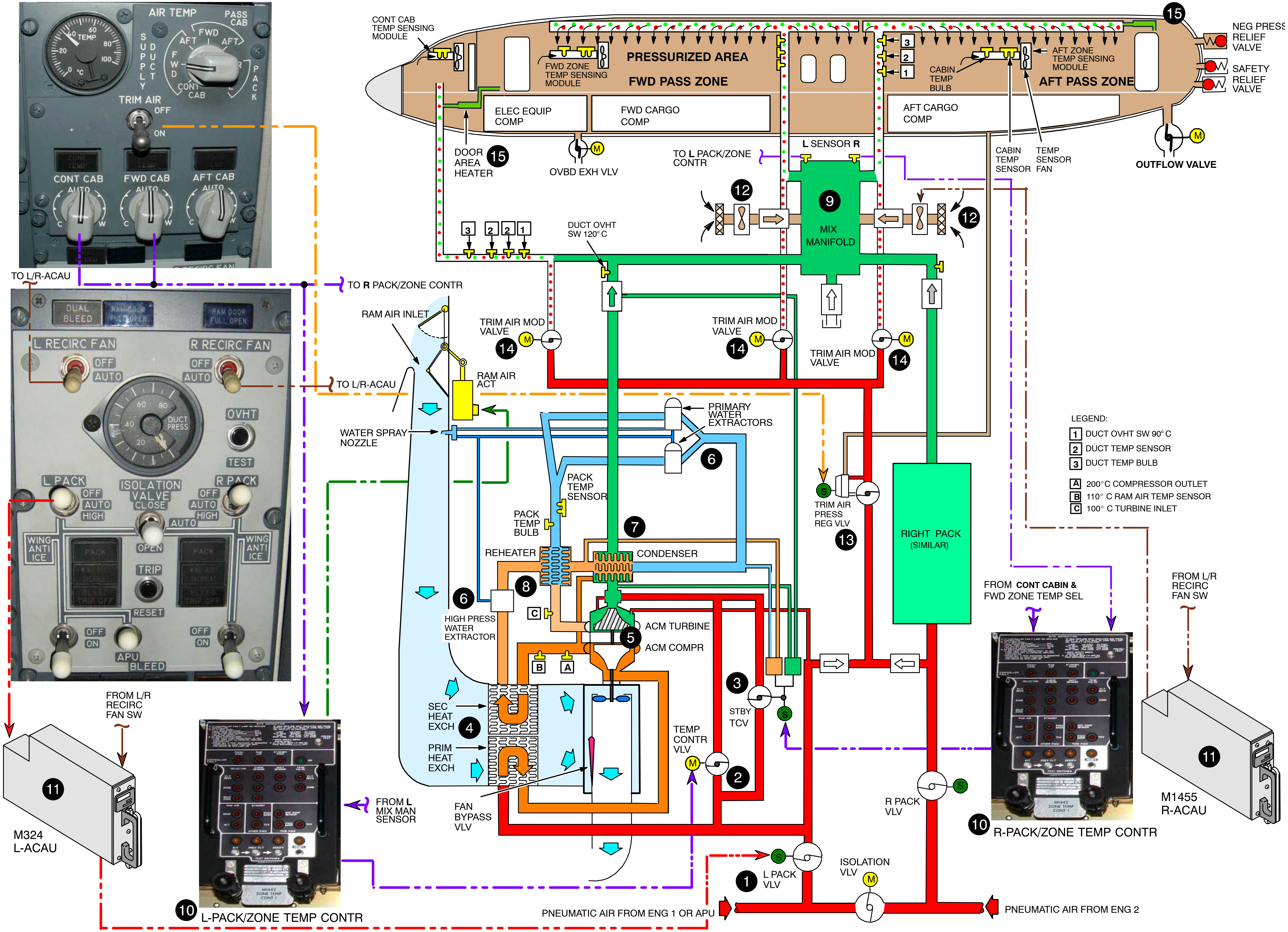


Figure 1 Air Conditioning Basic Schematic (Cont.)

Reference to Figure 2 Pressurization System Schematic

ATA 21 AIR CONDITIONING

21-30 GENERAL

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The airplane operates at altitudes where the oxygen density is not sufficient to sustain life. The pressurization control system keeps the airplane cabin interior at a safe pressure altitude. This protects the passengers and crew from the effects of hypoxia (oxygen starvation).

The system controls the position of the outflow valve to control cabin pressure. The air conditioning packs force air into the airplane pressure vessel (cabin). The pressurization system controls the rate at which the air flows out of the cabin. This maintains a safe cabin pressure. The pressurization control systems are designed for a nominal operating pressure of 7.8-8.35 psid with a maximum operating pressure of 8.45 psid.

Automatic Pressurization Control

In the automatic mode of operation, the system uses a redundant system of digital pressure controllers to schedule cabin pressurization through all phases of flight. The active pressure controller keeps cabin altitude at a safe comfortable pressure altitude (8,000 ft ISA maximum). The pressure controllers are line replaceable units and incorporate standard front face bite.

There are two digital CPCs (**C**abin **P**ressure **C**ontrollers). Each CPC has its own systems interface and valve motor system. This gives the AUTO mode of control a dual redundant architecture. Only one CPC controls the outflow valve at any time. The other CPC is a backup. The active controller changes with every flight or with an autofail event.

The CPCs use data buses to interface with the drive electronic boxes on the valve. The electronics boxes drive the automatic mode motors. Altitude switches on each drive electronic box will override CPC signals and close the outflow valve if cabin altitude pressure is 14,500 feet. This function will not effect manual mode operation of the outflow valve.

MANUAL PRESSURIZATION CONTROL

In the manual mode of operation, the flight crew has direct control of the outflow valve from the P5 panel.

The manual control mode overrides and bypasses the two CPCs. The manual control system has its own valve motor system. This gives the pressurization control system a triple redundant architecture.

In manual mode, the pilot uses the control module toggle switch to operate the outflow valve. The manual valve motor has no control electronics box, and no pressure switch.

1 Aft Outflow Valve

The aft outflow valve controls the air flow out of the airplane fuselage.

The valve is a double gate type valve. The valve has two 28v dc motors and one 48v dc motor. Only one motor drives the valve at a time. All three motors use the same actuator mechanism.

2 Overboard Exhaust Valve

The overboard exhaust valve has two functions.
It controls the quantity of equipment cooling exhaust air that flows overboard and it operates in a smoke clearance mode.

3 Positive Pressure Relief Valve

The cabin pressure relief system is a fail safe system.

Positive pressure relief valves protect the fuselage structure from overpressure if the automatic system fails. They opens and release pressure at 8.95 psid.

4 Negative Pressure Relief Valve

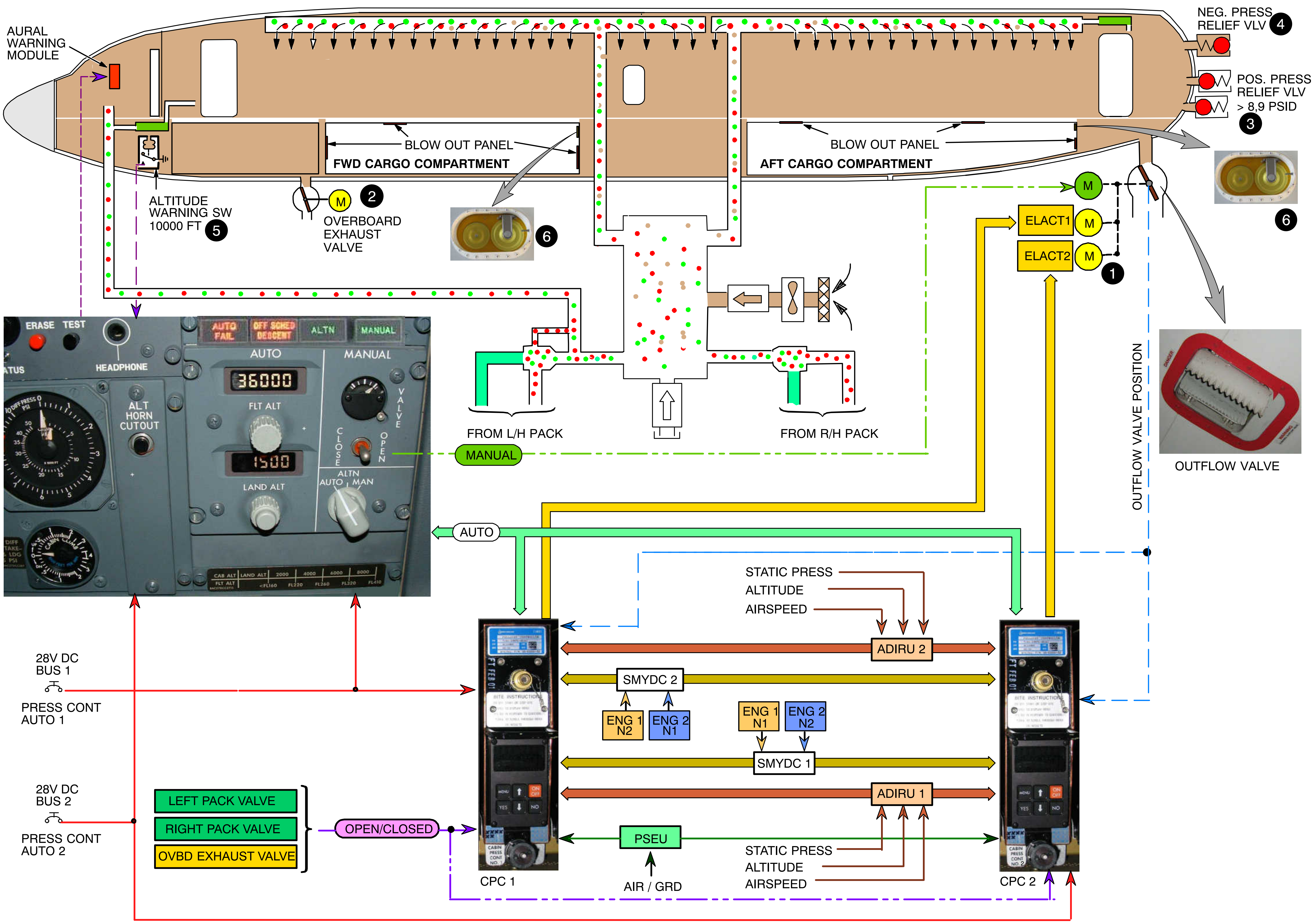
The negative pressure relief valve opens when pressure outside of the airplane is 1.0 psi more than the pressure inside of the airplane (-0.1 psid).

5 Cabin Altitude Warning

When the cabin altitude reaches 10,000 feet, the cabin altitude warning horn sounds. When the cutout switch is pressed, cuts out intermittent cabin altitude warning horn.

6 Pressure Equalization Valves

The cargo compartment pressure equalization valves let the pressures in the cargo compartments change.



B737-600/700 SHOWN B737-800/900 EQUAL

Figure 2 Pressurization System Schematic

Reference to Figure 3 Equipment Cooling System Schematic

ATA 21 AIR CONDITIONING

21-27 GENERAL

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The equipment cooling system uses these two systems to remove heat from equipment:

- Supply system (pushes air)
- Exhaust system (pulls air).

The supply system and the exhaust system use fans to move air. Each system has a primary fan and an alternate fan.

The supply and exhaust fans move air through ducts and manifolds. The ducts and manifolds connect to shrouds around the electronic and electrical equipment.

Supply

The supply fans push air to these components:

- P1, P2, P3 (display units)
- P9 panel (FMC control display units)
- Equipment racks in the EE compartment.

Exhaust

The exhaust fans pull air from these components:

- P1, P2, P3 (display units)
- P9 (FMC control display units)
- P6 (circuit breaker panel)
- P5 (control and indication)
- P8 (center aisle stand)
- Equipment racks in the EE compartment.

LOW FLOW SENSORS

The low flow sensors monitor air flow for the equipment cooling system. When airflow cooling quality through the equipment is not sufficient, the sensor supplies an indication.

The low flow sensors supply an alarm signal to these components for indication:

- MASTER CAUTION Light comes on
- The related EQUIP COOLING OFF light comes on
- ADIRS (crew call) alert occurs if the airplane is on the ground.
- Flight recorder/mach airspeed module

OVERBOARD EXHAUST VALVE

The overboard exhaust valve lets exhaust air go overboard when the airplane is on the ground. The exhaust air supplements heating in the forward cargo compartment in flight.

When the airplane is in flight, the normal position for the OEV (**O**verboard **E**xhaust **V**alve) is closed.

When the airplane is on the ground, the valve actuator is in the NORMAL position. The valve position is a function of airflow (the valve is open until the airplane pressurizes).

When the airplane is in pressurized flight, the normal position for the overboard exhaust valve is closed. Switch position has an effect on valve position. A 28v dc electromechanical rotary actuator opens the valve in flight for more airflow or for smoke removal.

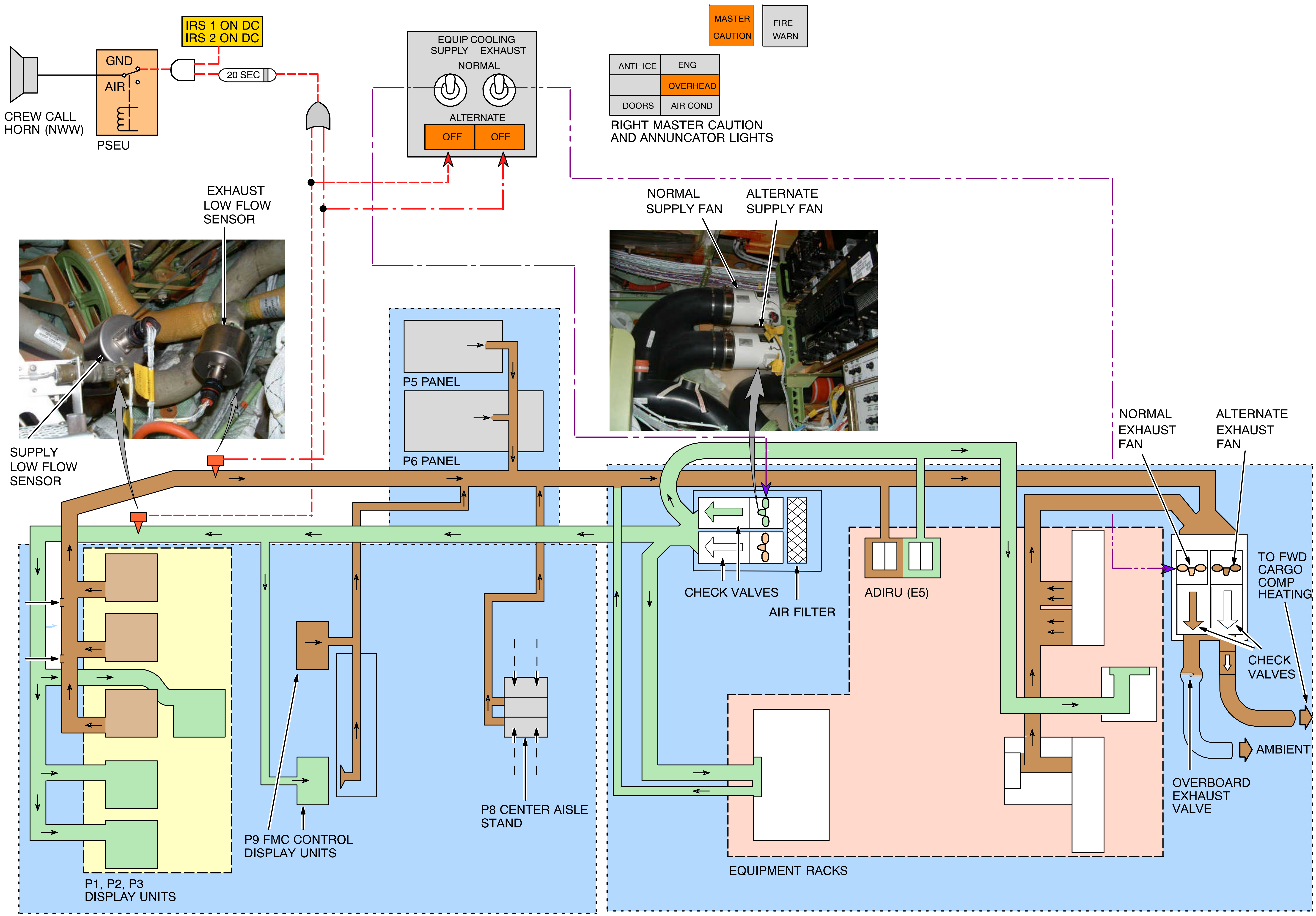


Figure 3 Equipment Cooling System Schematic

Reference to Figure 4 Y/D System Description and Location

22-23 YAW DAMPER SYSTEM

GENERAL

The yaw damper system keeps the airplane stable around the yaw axis. When in flight, the yaw damper commands rudder movement in proportion to, and opposite to, the yawing moment. This keeps dutch roll to a minimum and makes the flight smoother.

1 Yaw Damper Engage Switch

You engage the yaw damper system with a switch on the flight control panel. When you engage the yaw damper, the B Hydraulic system should be ON. This is not a precondition for holding the Yaw Damper switch in the ON position.

2 Yaw Damper Disengage Light

The disengage warning light is above the switch. The light shows if the yaw damper is not engaged while power is on the airplane.

3 Stall Management Yaw Dampers (SMYD 1+2)

The SMYD 1 controls the primary yaw damping function and the stall management function. For primary yaw damping, SMYD 2 monitors the yaw damping calculations of SMYD 1. These calculations must agree before SMYD 1 commands rudder movement. If the calculations of the two SMYDs do not agree, primary yaw damping disengages. SMYD 1 receives data from both ADIRUs and sends commands to the main rudder PCU. It is enabled for primary yaw damping operation when the FLT CONTROL B switch on the flight control panel is ON. The trailing edge flaps up limit switch sends flap position data to SMYD 1. The SMYD uses this during yaw damping to limit rudder movement when flaps are up.

4 Yaw Damper Indicator

The yaw damper indicator, on the P2 panel, shows rudder movement due to the yaw damper. The yaw damper moves the rudder a maximum of 2 degrees with flaps up, and 2 1/2 degrees with flaps down, in each direction to reduce dutch roll.

5 Main Rudder PCU

The main rudder PCU (**P**ower **C**ontrol **U**nit) is a hydraulic component that moves the rudder. It receives commands from the SMYD 1 to decrease unwanted yaw motion.

6 Solenoid Valve (Main Rudder PCU)

Discrete signal from smyd 1 to engage yaw damping to main rudder PCU.

7 Electrohydraulic Servo Valve (Main Rudder PCU)

Receives signals from SMYD 1 to deflect Main Rudder Actuator for yaw damping.

8 LVDT (Main Rudder Pcu).

The LVDT on the main rudder PCU sends rudder position feedback to SMYD 1 and to the yaw damper indicator to show rudder movement.

9 ADIRU

The air data inertial reference units send airspeed and inertial reference data to the SMYD's

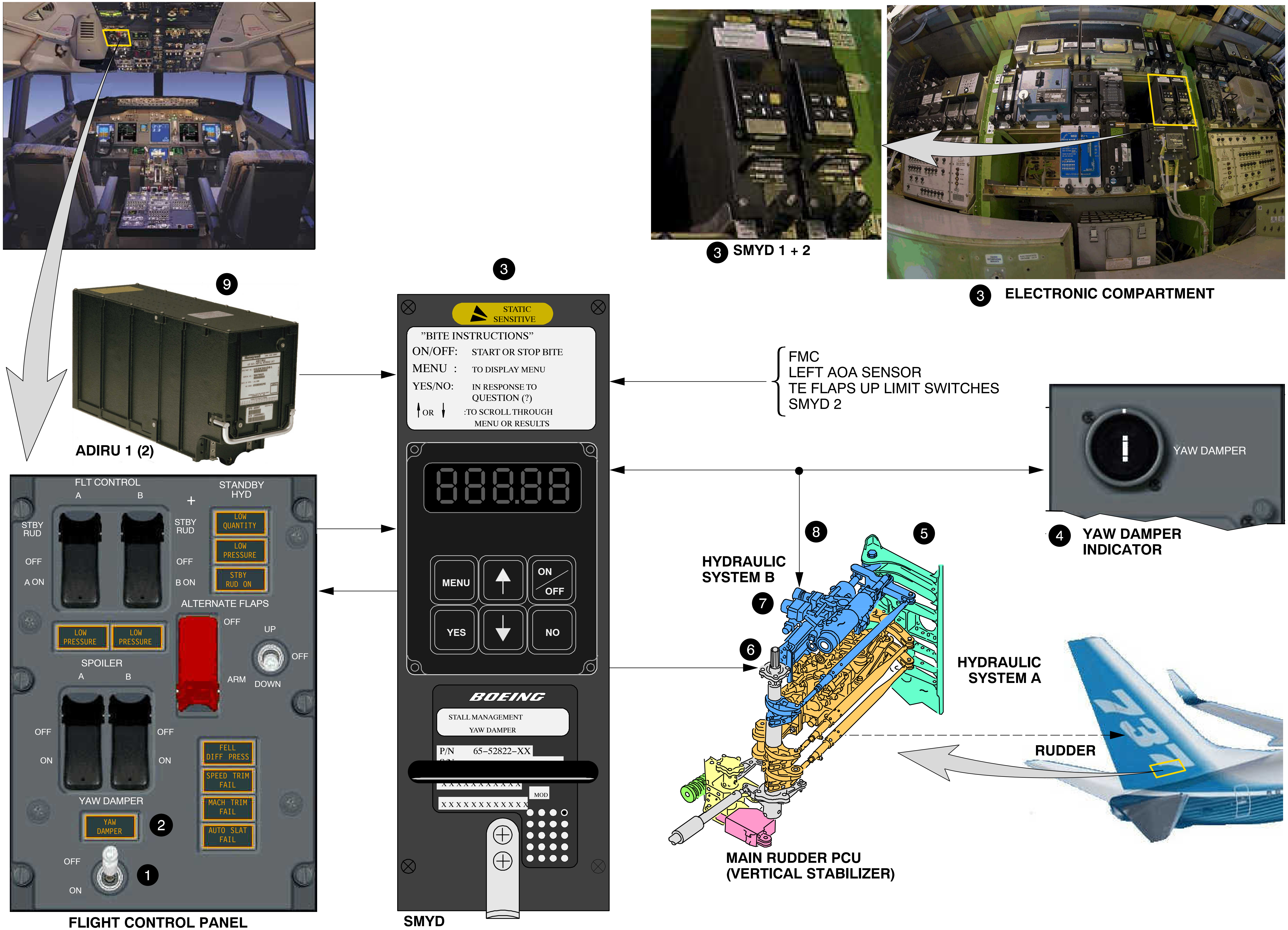


Figure 4 Y/D System Description and Location

Reference to Figure 5 DFCS-Autopilot

ATA 22 AUTOFLIGHT

22−10 DFCS-AUTOPILOT

GENERAL

The SP300 DFCS is the standard autopilot system for the B737−600/700/800/900 airplanes. The DFCS has two identical FCCs, a common MCP and actuators for input to the Flight Control System.

1 FCCs

Each FCC provides A/P including automatic Stabilizer Trim, F/D, Mach Trim, Speed Trim and Altitude Alert. The FCC provides CAT III−A landing capability (minimum view is 50 feet vertical and 200 m horizontal). Prior to touch down, the pilots have to align the airplane to the runway manually. They do this by pressing the rudder pedals.

2 MCP

When the flight crew selects mode commands and flight path variables on the MCP, the data goes to the FCCs on a digital data bus. The MCP also sends BITE data to each FCC.

3 Actuators

The A/P aileron actuators send the aileron actuator position data to the onside FCC. This position data comes from the LVDT (**L**inear **V**ariable **D**ifferential **T**ransformer). The FCC A sends a signal to A/P aileron actuator A to engage the detent solenoid valve. It also sends the roll command signals to this actuator. The FCC B sends a signal to A/P aileron actuator B to engage the detent piston. It also sends the roll command signals to this actuator.
Each FCC sends its onside aileron position data to the other FCC. The A/P elevator actuators send the elevator actuator position data to its onside FCC.

4 Positions Sensors

The aileron position sensor measures the position of the ailerons. It sends a signal in proportion to this position to the FCCs. One spoiler position sensor measures the position of spoiler #4. Another spoiler sensor measures the position of spoiler #9. The sensors send position signals to the FCCs. The stabilizer position sensors measure the position of the stabilizer. Stabilizer position sensor A sends a position signal to FCC A and to the FDAU Stabilizer position sensor B sends a position signal to FCC B.

5 DEU/Display Units

The indication on the PFDs are the FMA(**F**light **M**ode **A**nnunciator) of the A/P and A/T functions.

6 FMC

The FMC gives vertical and horizontal navigation and guidance informations and commands to the FCCs to steer the aircraft and is the BITE interface for the FCCs.

7 ASAs

The purpose of the autoflight status annunciators is to show, Autopilot warning, Autopilot disconnect, A/T (Autothrottle) disengage and BITE test.

8 PCUs

The ailerons and elevators are powered by two independent hydraulic power control units connected to hydraulic system A+B. Either power unit is capable of providing full power control response to aileron and elevator control system inputs.

9 CDU

The CDU is the Interface to read out faults of the FCCs and to start the BITE Function via the FMC.

10 Nav Receivers

The FCCs receive digital data from MMR receivers 1 and 2. The MMR receivers send ILS localizer and glideslope deviation data to the FCCs.

FCC A receives digital data from the VOR/MB 1 receiver. FCC B receives digital data from the VOR 2 receiver. The VOR receivers send VOR bearing data to the FCCs. FCC A receives digital data from the DME 1 interrogator. FCC B receives digital data from the DME 2 interrogator. The DME interrogators send DME distance data to the FCCs.

11 Force Transducer Pitch/Roll

The purpose of the CWS (Control Wheel Steering) force transducer is to supply electrical signals which vary in proportion to the force on the transducer to the FCCs.

12 A/P Disengage Switches and TO/GA

When you push the A/P disengage switch once, the switch stops 28V DC power. This signal disengages the active autopilot. When you push either TO/GA switch, a ground goes to SMYDs 1 and 2,
A/T computer and FCC A and B.

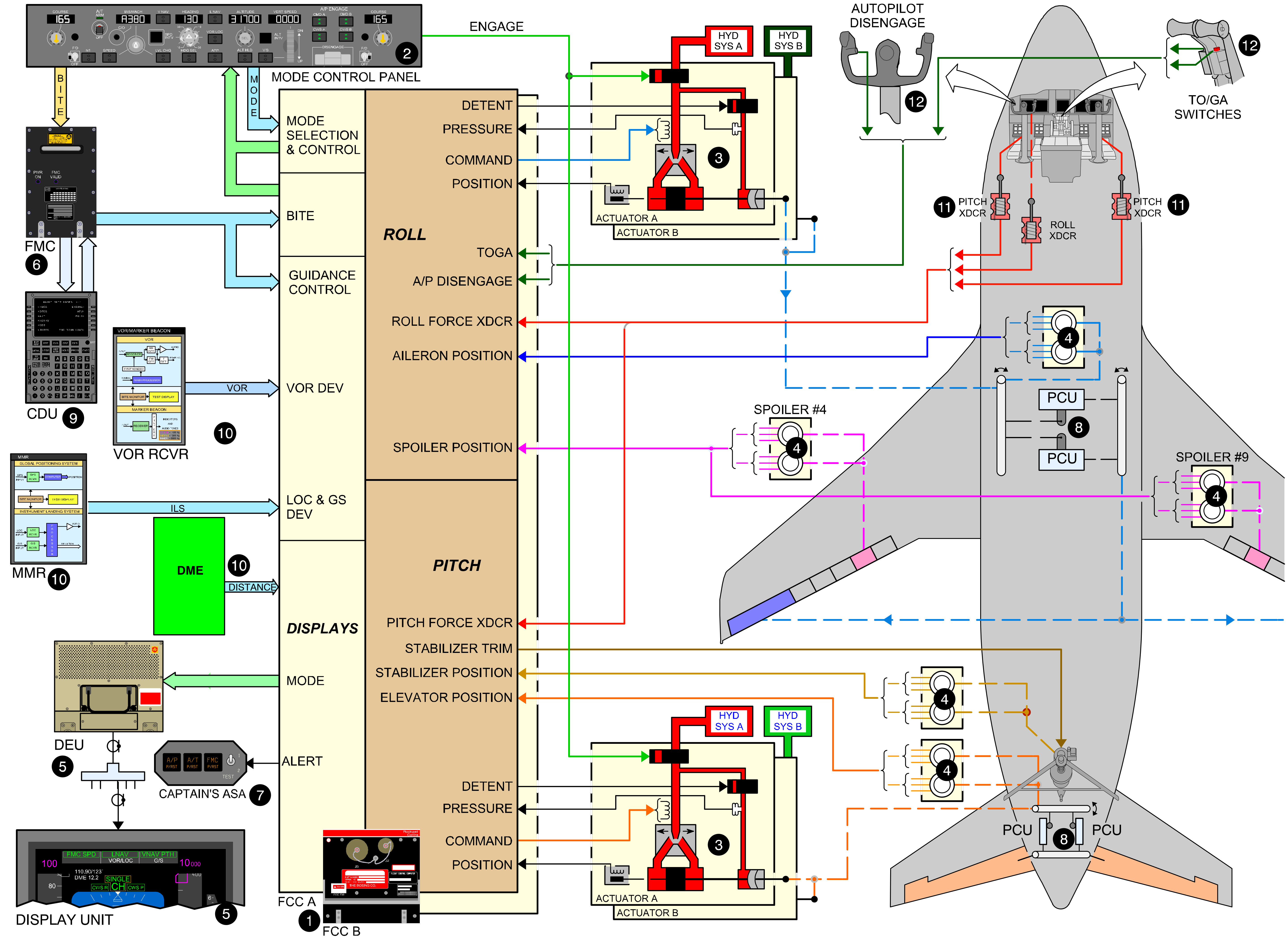


Figure 5 DFCS-Autopilot

Reference to Figure 6 Autothrottle-Schematic

22-31 AUTOTHROTTLE

GENERAL

The A/T (**A**utothrottle) system is part of the FMS (**F**light **M**anagement **S**ystem).
It controls engine thrust in response to mode requests from MCP (**M**ode **C**ontrol **P**anel) and Flight deck switches.It operates from takeoff to touchdown. The pilot uses the DFCS (**D**igital **F**light **C**ontrol **S**ystem) and the A/T system to automatically fly the airplane. The operator interface to the A/T-system is through the MCP. Several systems and their components send and receive autothrottle information. The A/T mode information shows on the CDS Displays.

1 DFCS MCP

The MCP sends this data to the A/T computer, Target mach and airspeed, Selected altitude, Flight path angle rate, Left and right spoiler angle and DFCS modes.

2 SMYD

The SMYD sends this data to the A/T computer:

- Flap angle
- Minimum operating speed
- Flap up logic
- Main gear down logic
- Air/ground discrete.

3 FMC

The FMCs send this data through the FMCS transfer relays to the A/T Computer

- Gross weight
- FMC altitude
- Selected altitude
- N1 targets
- Minimum speed
- BITE test information
- FMC modes
- GMT/Date.

4 RA

The RA R/Ts (**R**eceiver/**T**ransmitters) send radio altitude to the A/T computer. The A/T uses this input during approach.

5 EEC (Electronic Engine Control)

The TRs (**T**hrust Lever **R**esolvers) send the TRA (**T**hrust Lever **R**esolver **A**ngle) to the EECs (**E**lectronic **E**ngine **C**ontrols). The EECs use these inputs to produce an N1 command. The EECs sends this data to the A/T computer:

- TRA
- N1 command indicated
- TRA for max forward idle
- Estimated corrected thrust
- TRA for actual N1
- TRA for N1 max
- TRA for N1 target
- TRA for 5 degree/sec response.

6 ADIRU

The left ADIRU and the right ADIRU send this data to the A/T compute:

- Altitude (baro and corrected)
- Mach- Airspeed
- Air temperature
- VMO/MMO
- Altitude rate air pressure
- Angle-of-attack-Attitude (roll and pitch), Acceleration
- Ground speed
- Inertial vertical speed and Attitude rate (pitch).

7 A/T Computer

The autothrottle computer is a digital computer. It takes inputs from many systems to calculate the thrustlever commands through the ASMs. The CPU monitors and decides if the control law data is satisfactory and engages/disengages the A/T System. While engaged, the CPU sends a signal to hold the A/T ARM switch in the ARM position.The CPU sends a signal to the ASAs. The CPU continuously monitors system operation.

8 A/T Servomotors

The ASMs receive commands from the A/T computer. The ASMs use these commands to individually move the thrust levers forward or aft through two separate gear box assemblies. Each thrust lever has its own servo motor and gear box. The ASM connects an output shaft to a gearbox and sends rate feedback to the A/T.

9 ASA

Indicates if A/T is disengaging, in Bite function or failed during Power Up test.

10 MCDU

Bite Test Interface for the A/T System.

11 DEU/CDS

Indication for N1 Targets and TMA (**T**hrust **M**ode **A**nnunciator).

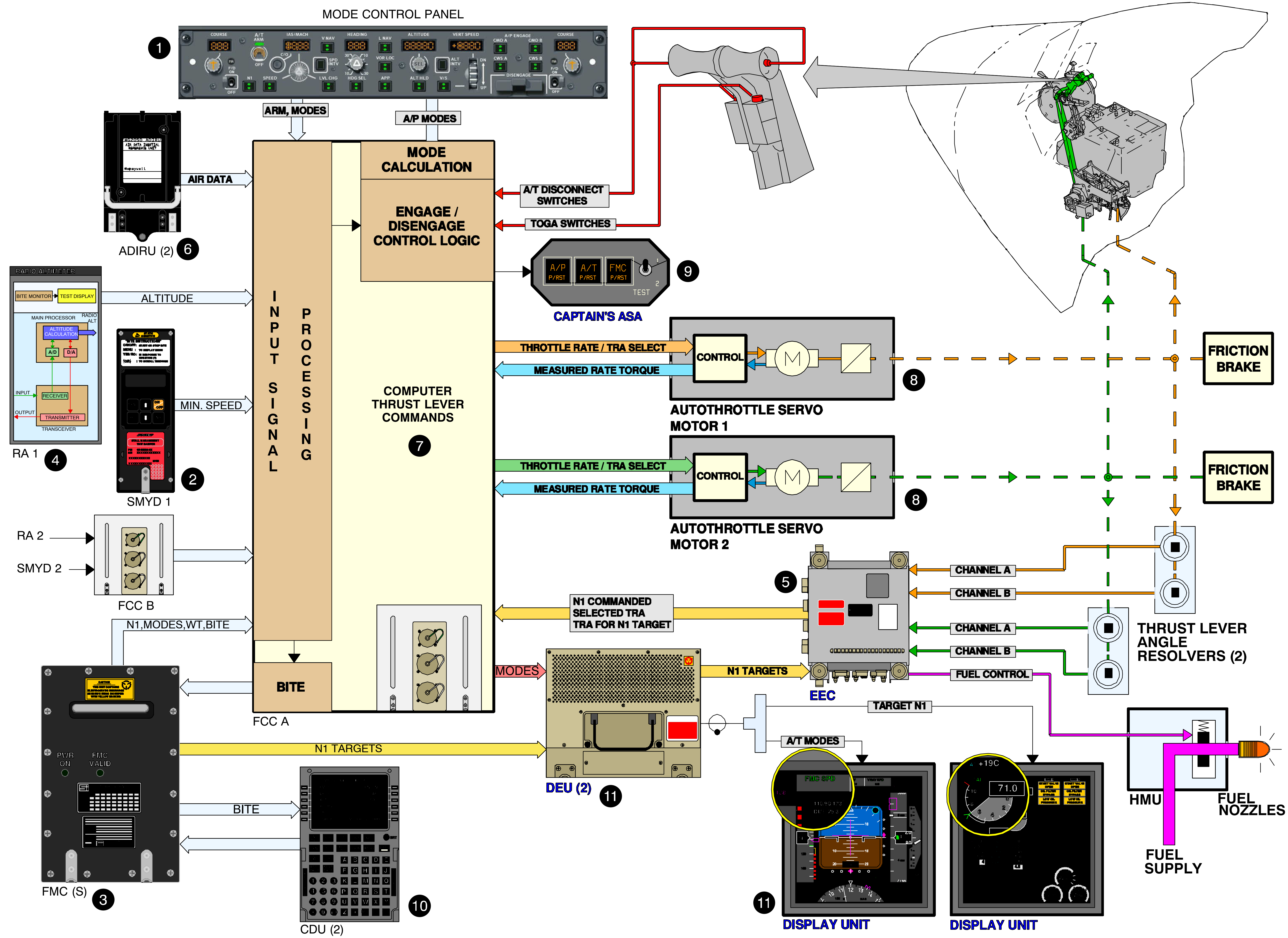


Figure 6 Autothrottle-Schematic

Reference to Figure 7 Audio Management System Overview

ATA 23 COMMUNICATION

23-51 AUDIO MANAGEMENT

GENERAL

The flight crew uses the flight interphone system to speak with each other and the ground crew.
Flight and maintenance crews use the flight interphone system to get access to the communication systems.
You can also use the flight interphone system to monitor the navigation Receivers.

1 The ACP's

The ACP (**A**udio **C**ontrol **P**anel) control the audio signals to and from the flight crew.
The flight crew uses the audio control panels for these functions:

- Listen to the communication and navigation receivers
- Adjust the volume of the received audio
- Select a transmitter and microphone
- Key the microphone.

2 THE REU

also controls the communication with the service interphone and related electronics equipment. During a system failure, emergency operation bypasses all active system circuitry and maintains airplane to ground station communication. The REU (**R**emote **E**lectronic **U**nit) sends audio signals to the headsets and to the flight interphone speakers.

3 Flight Crew Interfaces

The flight crew uses microphone (mic) switches on these components to send audio to the REU:

- Control wheel
- ACP
- Hand microphone
- Oxygen mask
- Headset
- Hand mic.

4 Communications Radios

The REU sends PTT (**P**ush-**T**o-**T**alk) and microphone audio to the transceivers and receives audio back from them.

5 Navigation Receivers

The REU receives voice and Morse code identification tones.

6 Passenger Address System

Lets the flight crew make announcements to passengers.

7 Service Interphone System

Lets the flight crew speak with attendants and service personnel.

8 Voice Recorder

Records the flight crew microphone and received audio.

9 Ground Proximity Warning Computer

Provides Warnings for:

- Terrain
- RAAS
- TCF
- WNDSHR
- OBSTACLES

10 TCAS (Traffic Alert And Collision Avoidance System)

Provides Traffic Cautions and Warnings.

11 FCC (Flight Control Computer)

Gives discrete signals to the REU.
This signal activates an altitude alert tone generator.

12 WXR (Weather Radar)

Lets the flight crew monitor WXR windshear warnings.

13 Selcal

Signals Flightcrew a selective call from a ground station.

14 Flight Interphone Jack

There is a flight interphone jack on the P19 external power panel.

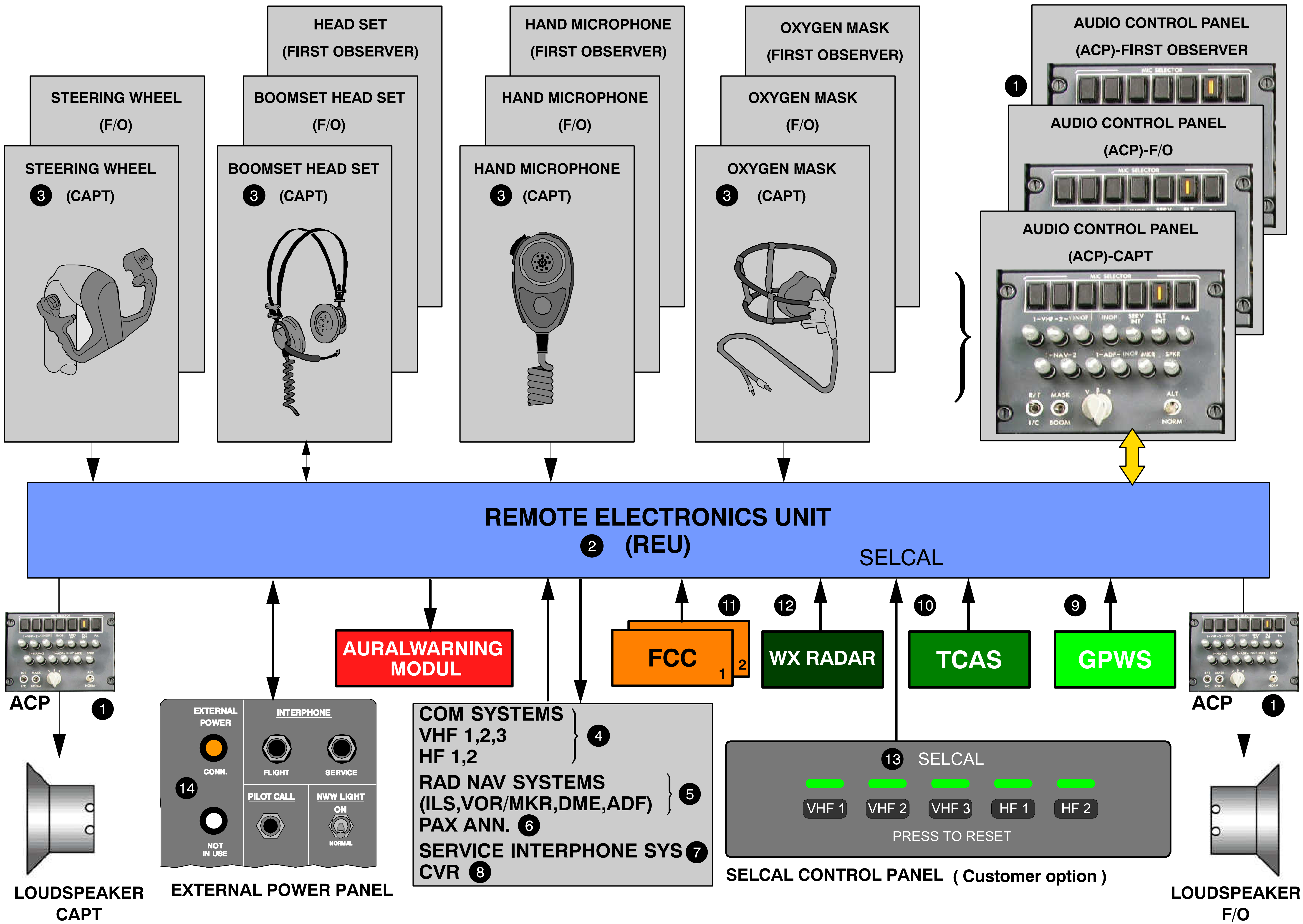


Figure 7 Audio Management System Overview

Reference to Figure 8 Service and Flight Interphone System

23-41/51 FLIGHT/SERVICE INTERPHONE

1 REU

The REU (**R**emote **E**lectronics **U**nit) controls the communication between these:

- Three flight deck stations
- Service interphone
- Flight interphone.

The REU contains three identical station cards for these crew members and an AAU (**A**udio **A**ccessory **U**nit) card. The card contains circuitry for flight and service interphone, alert tone generation and various audio accessory functions.
The station cards get control inputs from the ACPs (**A**udio **C**ontrol **P**anels) and microphone PTT (**P**ush-**T**o-**T**alk) switches.
The receiver circuits receive audio inputs from the communication and navigation systems, passenger address amplifier, service interphone and flight interphone. The audio goes to summing amplifiers. The summing amplifiers send the audio to the speaker mute/volume logic circuits, CVR amplifier and headphone amplifier.
The transmitter circuits route the microphone audio and/or PTT to the selected communication system.
The "hot mike-function" of the boom/oxygen mike is established to provide voice recorder records.

2 Audio Control Panel

You use the ALT-NORM switch to select either normal or emergency operation of the flight interphone system. Each station operates independently. When you select ALT, the flight interphone system operates in the emergency mode. The only ACP controls that operate are the BOOM-MASK switch and the R/T position of the PTT switch. If the REU loses power the ACP loses power too, the ALT function automatically takes places.

3 Service Interphone

The service interphone system is for the:

- Flight crew
- Attendants
- Ground crew.

The flight crew selects the service interphone function from the ACP (**A**udio **C**ontrol **P**anel). Flight interphone microphones send audio to the Remote Electronics Unit AAU Card. The AAU circuit card in the REU contains service interphone circuits.
Flight interphone headsets and speakers get audio from the REU. The handset jack connects to the system without ACP control. The attendants operate a handset to connect into the system. An attendant panel connects the handset to the REU.
The ground crew microphones are connected into the system through the service interphone switch. You must turn on the service interphone switch. When the service interphone switch is ON, they can speak to each other, the flight crew and the attendants. The service interphone circuits have an audio mixer. The audio mixer combines the microphone audio from the flight crew station cards, the attendant stations, and the service interphone jacks. The service interphone circuits increase the level of the audio signal as soon as an engine run signal from the running relays is provided.

4 Voice Recorder

Records the flight crew microphone and received audio.

5 Flight/Service Interphone Jack

There is a flight interphone jack on the P19 external power panel.

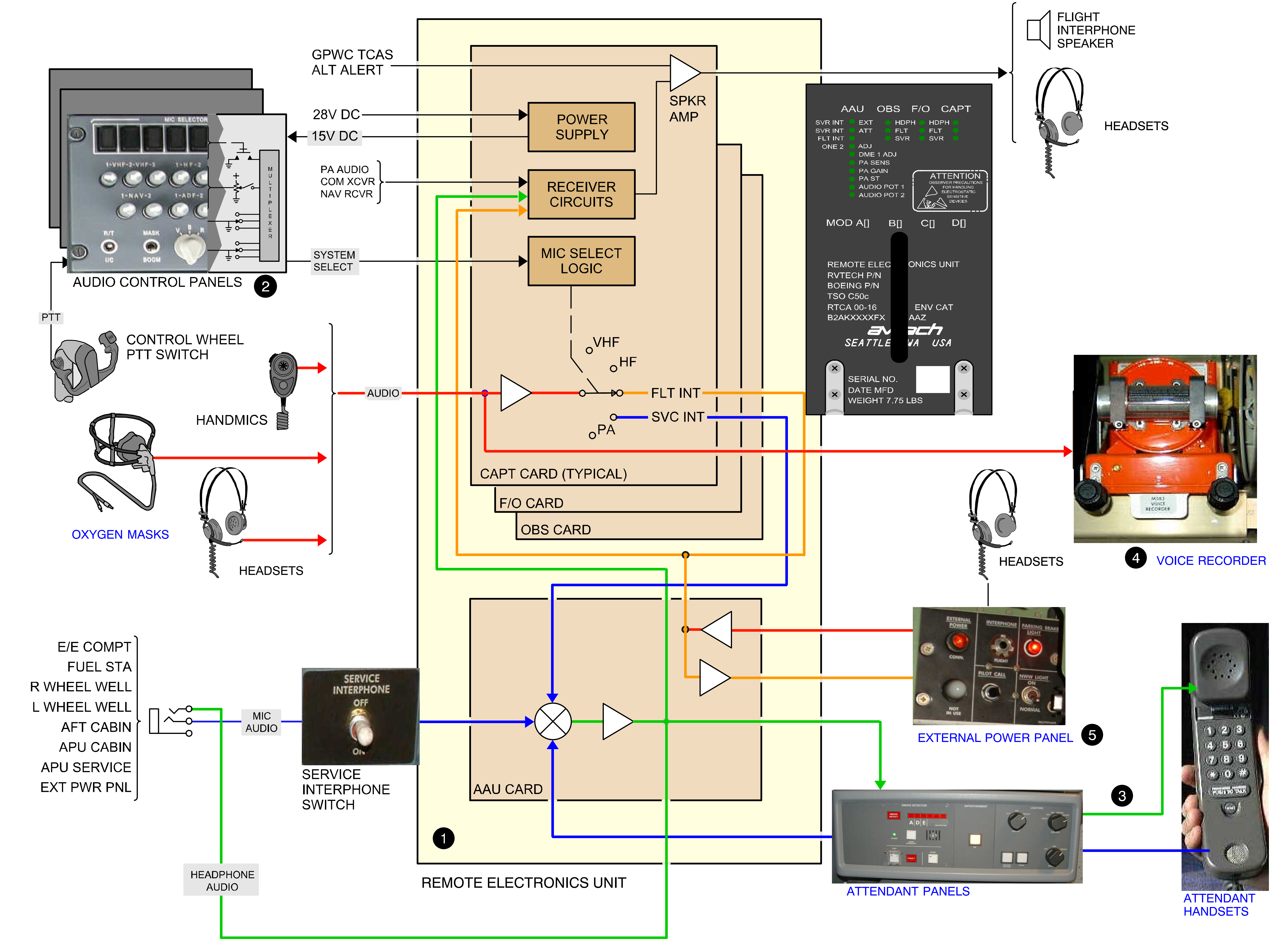


Figure 8 Service and Flight Interphone System

Reference to Figure 9 Cabin Interphone System/Flight and Ground Crew Call System

23−40 INTERPHONE SYSTEM

GENERAL

The flight/ ground crew call system tells the:

- flight compartment personnel that there is a call from the cabin attendants or ground.
- attendants there is a call from the flight compartment or another attendant panel
- ground Crew that there is a call from the Flight Compartment.

The flight/ground crew call system lets the flight crew, attendants and ground crew call each other.

These are the calls that can be made:

- Flight compartment to attendant/ground stations
- Attendant station to flight compartment
- Attendant station to attendant station
- Ground to Flight Compartment.

1 Handset

The attendants use handsets to speak with each other, flight deck and also use them to make announcements on the PA. Lift the handset off the hook. This connects the handset microphone and speaker to the service interphone system.

- Push 2 to call the pilot
- Push 5 to call the other attendant station
- Push 8 to call PA
- Push−to−talk button to make PA announcements
- Push 2 three times to alert the pilot
- Push the reset button to cancel the call

2 Attendant Panel Handset Logic Control Card

Call logic for call indication and reset logic
The handset logic control card turns on the attendant call lights at the two attendant stations, and sends a discrete signal to the passenger address amplifier to make a high/low chime.
For calls to the flight compartment, the handset logic control card turns on the call light in the passenger signs panel and sends a discrete signal to the aural warning module.
For calls to the other attendant station, the handset logic control card turns on the attendant call light at that station and sends a discrete signal to the passenger address amplifier to make a high/low chime.
When you lift the handset from the cradle at the other attendant station, the call light turns off.

3 Attendant Call Lights

The attendant call lights are on the forward and aft exit locator signs. They give visual indication:

- magenta for cockpit call
- green for attendant call
- amber for Lavatory call
- blue for Pax call

4 PA Amplifier

Aural indication high/low chime for calls from Flight Compartment to the attendants.

5 Passenger Signs Panel

Attendant/Ground crew call pushbuttons:
The passenger signs panel has an attendant call switch that sends a call signal to the handset logic control card in the forward attendant panel.

6 Aural Warning Modul

High chime indication for attendant call and ground crew call.

7 External Power Panel P19

Flight Compartment call Switch.

8 Ground Crew Call Horn

Indicates Ground Crew a Flight Deck Call

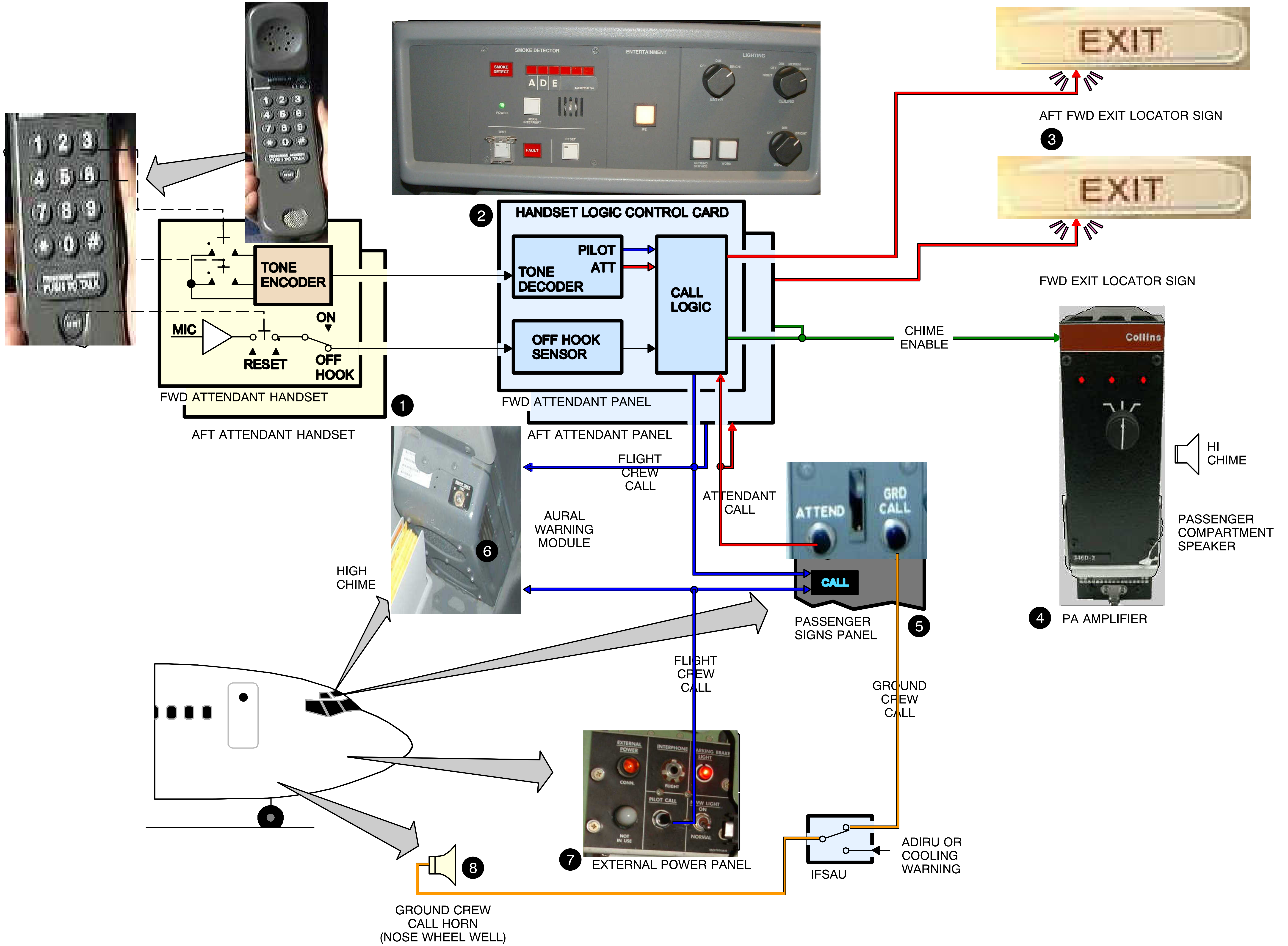


Figure 9 Cabin Interphone System/Flight and Ground Crew Call System

Reference to Figure 10 Passenger Address Interface

23-71 PASSENGER ADDRESS

GENERAL

The PA (**P**assenger **A**ddress) system supplies these to the passenger cabin:

- Passenger address announcements
- Pre-recorded announcements
- Boarding music
- Chimes.

1 PA Amplifier

The PA amplifier gets 28v dc from the 28v dc battery bus. The PA amplifier puts a priority on the audio inputs from these places:
Flight Deck, Attendants and Pre-recorded announcement and boarding music reproducer (PRAM).

It amplifies the audio input that has the highest priority and sends the signal to these places:

- Passenger cabin speakers
- Attendant speakers
- Passenger entertainment system
- REU and supplies chimes with other PA audio.

2 REU

The amplified audio to the REU goes through muting circuits for the forward and aft attendant speakers. When an attendant makes an announcement, the muting circuits stop the audio for that attendants speaker. The PA amplifier supplies the side - tone to the REU. The REU supplies the side tone to the flight crew headsets.

The PA amplifier supplies audio to these components and system.

3 Muting Relays

When an attendant makes an announcement, the muting circuits stop the audio for that attendants speaker.

4 Gain Control

The PA amplifier receives gain signals from the REU which receives inputs from the engine running relays. When you leave the engine-start lever for more than 5 minutes in position IDLE, the EEC provides an ”engine running” output. The level of pa-announcements increases by 6 decibels.

5 Engine Run Relays

When the engines operate, the PA amplifier gain increases to compensate for the increase in the ambient noise level.

6 PRAM

The PRAM (**Pre-R**ecorded **A**nnounce**m**ent) and boarding music reproducer provides boarding music and pre-recorded announcements on the PA system.

7 OXY IND Relay

The oxygen indicator relay supplies a discrete to the passenger entertainment video system control unit if there is a decompression. This makes the PRAM pre-recorded emergency message operate and the Video signal to turn off.

8 Flight Interphone System

First Priority output for the PA Amp. from the flight deck.

9 FWD ATT. Panel

Second priority for PA Announcements.

10 Lav and Pass Service Units

The PA system speakers supply audio to these places:

- Passenger cabin
- Lavatories
- Attendant stations

Each PSU (**P**assenger **S**ervice **U**nit) has a 6.5 inch speaker. There is a 5 inch speaker in each lavatory and at the attendant stations.

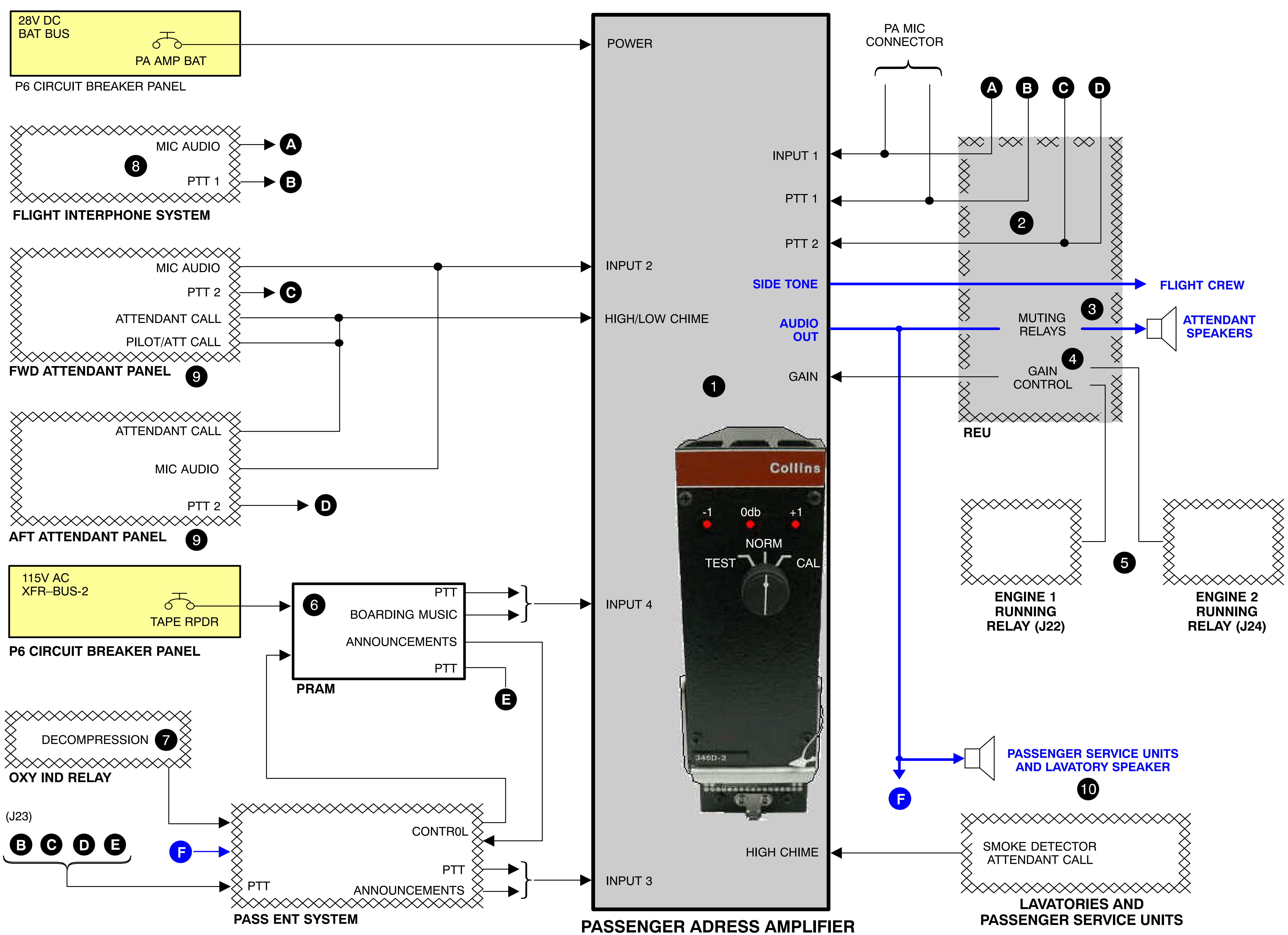


Figure 10 Passenger Address Interface

Reference to Figure 11 VHF-700/900 Collins System Architecture

23−21 VERY HIGH FREQUENCY SYSTEM

GENERAL

The VHF (**V**ery **H**igh **F**requency) communication system supplies voice and data communication over line−of−sight distances. It gives communication between airplanes or between ground stations and airplanes. The VHF system operates in the aeronautical frequency range of 118.000 MHz to 136.975 MHz.

1 RCPs

The radio communication panels are on the P8 aft electronics panel.
The radio communication panel supplies these to the VHF transceiver:

- ON/OFF control
- tuning data
- port select discrete.

Each radio communication panel can tune only one transceiver at a time. When you select an off−side radio, two off−side tuning lights come on. One light is on the radio communication panel that you use to make the selection. This is the off−side radio.
The other light is on radio communication panel of the radio you select. This is the on−side radio. Set the frequency in the standby frequency indicator. With RCPs you can tune each Communication transceiver on the Aircraft.

2 VHF Transceivers

The VHF antenna receives RF signals and sends them to the VHF communication transceiver through the coaxial cable.
The transceiver sends the RF signal through the receive circuits and then sends the audio to the flight interphone system. The VHF transceiver receives audio from the REU (**R**emote **E**lectronics **U**nit). The transceiver sends the signals through the transmit circuits and then to the antenna for transmission.
During transmission, the microprocessor receives a PTT (**P**ush-**T**o−**T**alk) signal from the REU.

3 ACARS

The ACARS MU receives the ground−to−air digital messages (uplink) and controls the transmission of the air−to−ground digital messages (downlink). VHF transceiver No. 3 is used to transmit and to receive data from/to the ground.
The ACARS MU sends these discrete signals to the VHF 3 transceiver:

- Port select discrete to set the tuning data source
- Data key to give a PTT signal
- Voice/Data to set transceiver voice or data mode

Push one of the two maintenance switches to start the BITE tests. Each screen display gives information to help the operator with maintenance procedures. The transceiver front panel has a flash memory access.

4 Antennas

The VHF antenna receives and transmits RF signals in the VHF frequency range.
The antennas are attached with 10 screws. An o−ring seals the coaxial connector.

5 Crosstalk Busses

When you select an off−side radio, the tuning signals go through the crosstalk busses to the offside radio communication device and tunes this receiver.

6 Port Select

Port select means input select. With the Port Select discrete available, the input selector contacts to input A. When the discrete is not available, the input reverts to input B. Port select is controlled by the off switches on the RCPs.

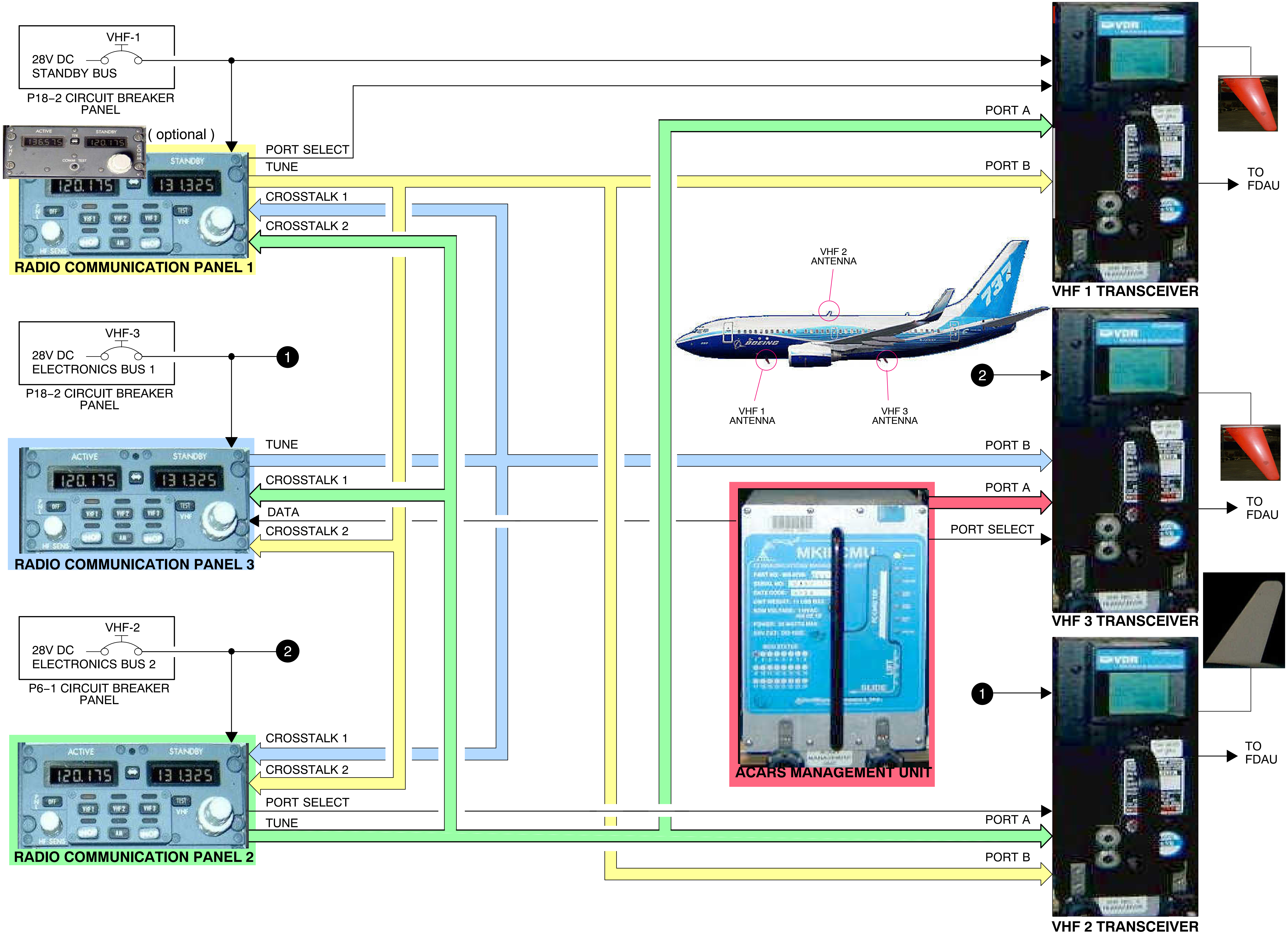


Figure 11 VHF-700/900 Collins System Architecture

Reference to Figure 12 Radio Management System Overview

23-13 RADIO MANAGEMENT

GENERAL

Any radio communication panel can control any communication transceiver.
At power up,
RCP 1 controls VHF 1,
RCP 2 controls VHF 2, and
RCP 3 controls VHF 3.
Push the radio tuning switch to select the transceiver for that radio communication panel. Each radio communication panel can tune only one transceiver at a time. When you select an off-side radio, two off-side tuning lights come on.

1 Audio Control Panel

The REU receives Radio selection of the ACP (HF,VHF)

2 Radio Communication Panel

The RCP (**R**adio **C**ommunication **P**anel provides these functions:

- VHF and HF radio selection
- Active/standby frequency selection
- HF sensitivity control
- Mode selection to the HF transceiver
- Off switch.
- Controls and Indicators.

The radio communication panel continuously does a self-test. The frequency indicators show PANEL FAIL when there is an internal failure of the radio communication panel. The radio communication panel continuously monitors the condition of the transceiver. If the transceiver had failed, the two frequency indicators show FAIL. The VHF communication test switch starts a confidence check of the VHF/HF transceiver (it bypasses the squelch circuit: you hear the background-noise of the received signal).

3 Very High Frequency

The VHF **(V**ery **H**igh **F**requency) communication system supplies voice and data communication over line-of-sight distances. It gives communication between airplanes or between ground stations and airplanes. The VHF system operates in the aeronautical frequency range of 118.000 MHz to 136.975 MHz.

4 High Frequency Communication

The HF (**H**igh **F**requency) communication system supplies voice communication over long distances. It gives communication between airplanes or between ground stations and airplanes.
The HF system operates in the aeronautical frequency range of 2 MHz to 26.999 MHz.
The system uses the earth's surface and an ionized layer to cause a reflection (skip) of the communication signal. The distance between skips changes due to the time of day, radio frequency, and airplane altitude.
The SSB - single side band selection uses the USB - upper side band.

5 ACARS

The ACARS (**A**ircraft **C**ommunications **A**ddressing and **R**eporting **S**ystem) is a datalink communication system. It lets you transmit messages and data between an airplane and an airline ground base.
A message from the airplane to the airline ground base is called a downlink.
A message from the airline ground base to the airplane is called an uplink.
To reduce crew workload, ACARS sends reports when necessary and at scheduled times of the flight.
These are typical ACARS reports:

- Crew identification
- Out, Off, On, In (000I) times
- Engine performance
- Flight status
- Maintenance items.

The ACARS (**A**ircraft **C**ommunication **A**nd **R**eporting **S**ystem) uses the VHF 3 transceiver to transmit data.

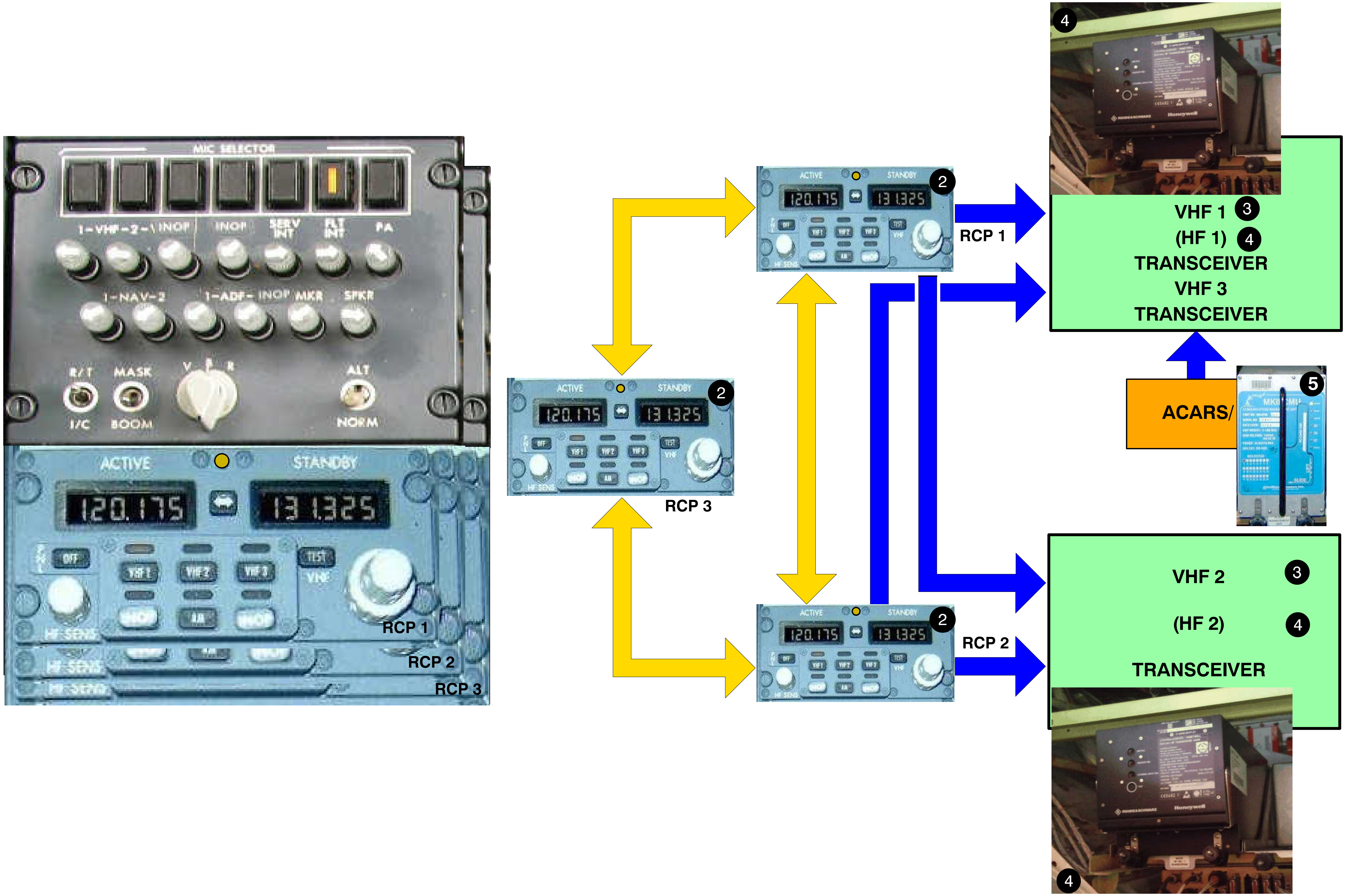


Figure 12 Radio Management System Overview

Reference to Figure 13 HF-Dual System

23-11 HF SYSTEM

GENERAL

The HF (**H**igh **F**requency) communication system supplies voice communication over long distances. It gives communication between airplanes or between ground stations and airplanes.
The HF system operates in the aeronautical frequency range of 2 MHz to 26.999 MHz.
The system uses the earth's surface and an ionized layer to cause a reflection (skip) of the communication signal. The distance between skips changes due to the time of day, radio frequency, and airplane altitude. The HF communication system interfaces with these components:

- ACP (**A**udio **C**ontrol **P**anel)
- REU (**R**emote **E**lectronics **U**nit)
- Flight data acquisition unit

1 RCP

Select any HF System and enter the frequency.

The HF control panel supplies these to the HF transceiver:

- ON/OFF control
- Tuning data
- Port select discrete
- Squelch control

2 ACP

Selects the HF System connected to the REU.

3 REU

The REU receives HF radio selection and volume control from the ACP and provides Mike selection.

4 PSEU

Sends a Test inhibit discrete to the HF Transceiver when the aircraft is in Air.

5 HF Transceiver

The HF transceiver receives microphone (mic) audio from the REU. Receiver audio goes from the HF transceiver, through the REU, to the flight interphone speakers and headsets. The HF transceiver supplies the received audio to the SELCAL decoder. When the output is less than 40 watts, there is no side tone. When the output drops below 30 watts, an LRU fault occurs

6 6 HF Antenna Coupler

The HF antenna coupler matches the transceiver 50 ohm impedance output to the antenna impedance at the set frequency. This decreases the VSWR (**V**oltage **S**tanding **W**ave **R**atio) to less than 1.3:1. The coupler uses 115v ac to operate. It does not need special cooling.
The coupler tunes in the aeronautical frequency range of 2 to 26.999 MHz.
Tuning occurs in 2 to 4 seconds, 7 seconds maximum.

7 HF Antenna

The HF antenna is on the leading edge of the vertical stabilizer. The antenna couplers are inside the vertical stabilizer. The HF antenna is a notch type antenna. It is a U-shaped fiberglass material. The antenna is sealed within the leading edge of the vertical stabilizer. The antenna receives the feed line from the antenna coupler.

8 SELCAL

The SELCAL decoder monitors the audio for SELCAL, calls that come from the airline ground operations.

9 FDAU

The HF transceiver supplies a key event to the flight data acquisition unit for key event marking.

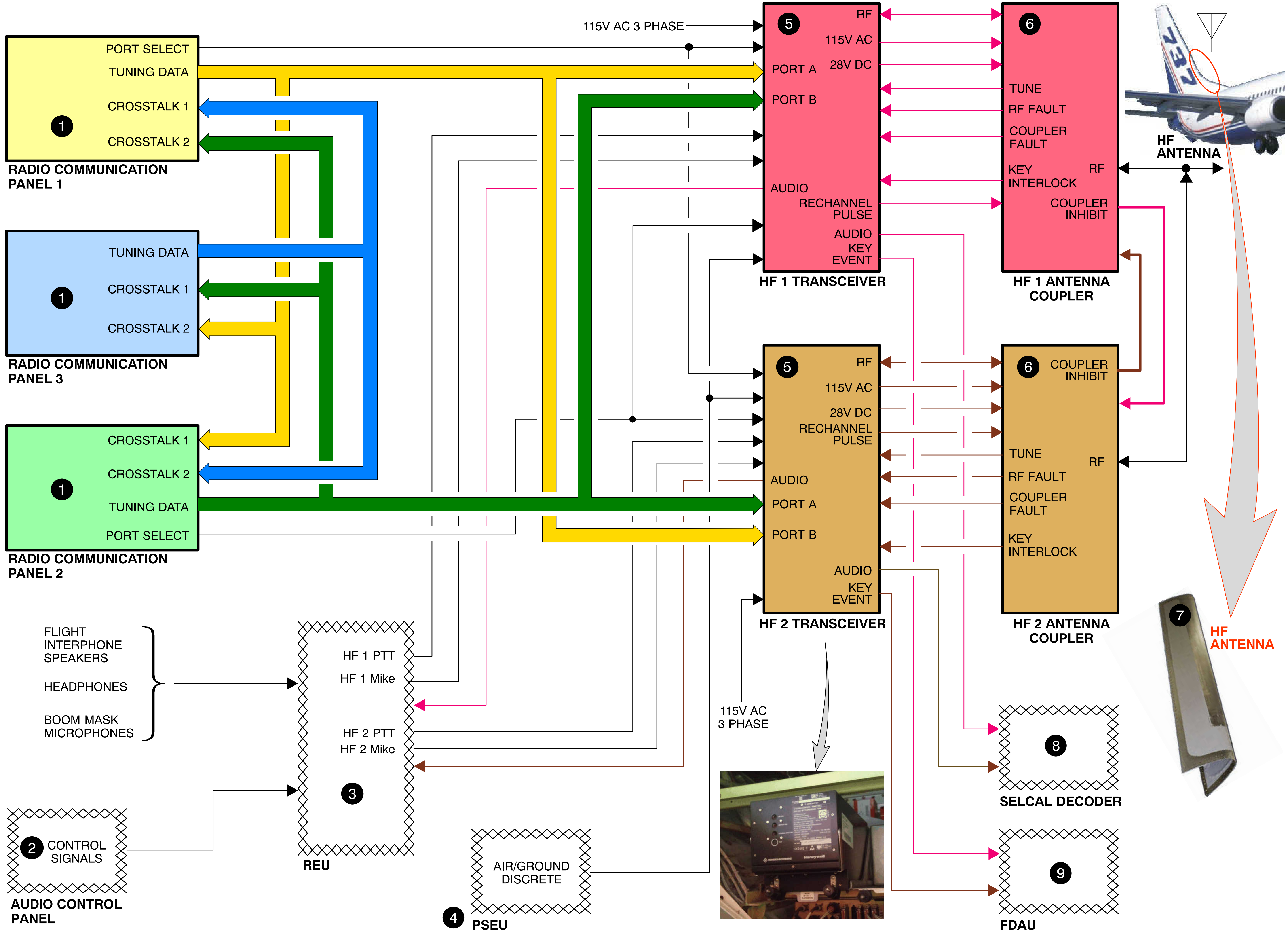


Figure 13 HF-Dual System

Reference to Figure 14 ACARS System

23-27 DATA TRANSMISSION&AUTO. CALLING

GENERAL

The ACARS is a voice and data communication system to manage flight plan data and maintenance data between the airplane and the airline and vice versa.

The ACARS MU receives the ground-to-air digital messages (uplink) and controls the transmission of the air-to-ground digital messages (downlink).

ACARS also connects to these systems to upload information from the airline operations or download information to the airline operations:

- Flight management computers
- Flight data acquisition unit
- Data loader control panel.

The ACARS MU is on the E3--3 shelf.

1 CDU's

You use the CDU (**C**ontrol **D**isplay **U**nit) to control the operation of the ACARS and display ACARS messages

2 FDAU

Report request uplink to the FDAU

3 FMC's

Route and airplane flight data from the FMCS
Route and flight data uplink to the FMC

4 Proximity Switch Electronics Unit

The ACARS MU receives analog discrete from the PSEU (**P**roximity **S**witch **E**lectronics **U**nit). These discretes determine the out, off, on, and in (000I) times. The ACARS sends standard reports at the 000I times. Proximity switch electronics unit which sends discrete signals for out, off, on and in (000I)

5 ACARS Program Switch Modules

There are three program switch modules.
Each program switch module contains DIP (**D**ual **I**nline **P**ackage) switches to give the registration code and airplane identification code.
Program pins define:

- The airplane model (737)
- Auto/manual channel change over
- ARINC 724/724(B) select

The ACARS program switch modules are on the E3-3 shelf behind the ACARS MU.

6 ACARS MU

The ACARS MU (**M**anagement **U**nit) receives the uplink data and controls the transmission of downlink data to and from the VHF transceiver. The MU processes only uplink messages that come with the airplane's registration code. This same code also goes on all downlink messages to identify the airplane.

7 REU

Remote electronics unit to distribute the chime annunciation for an incoming ACARS message.

8 Aural Warning Module

Gives Chimes for a received Message via ACARS

9 VHF 3 Transceiver

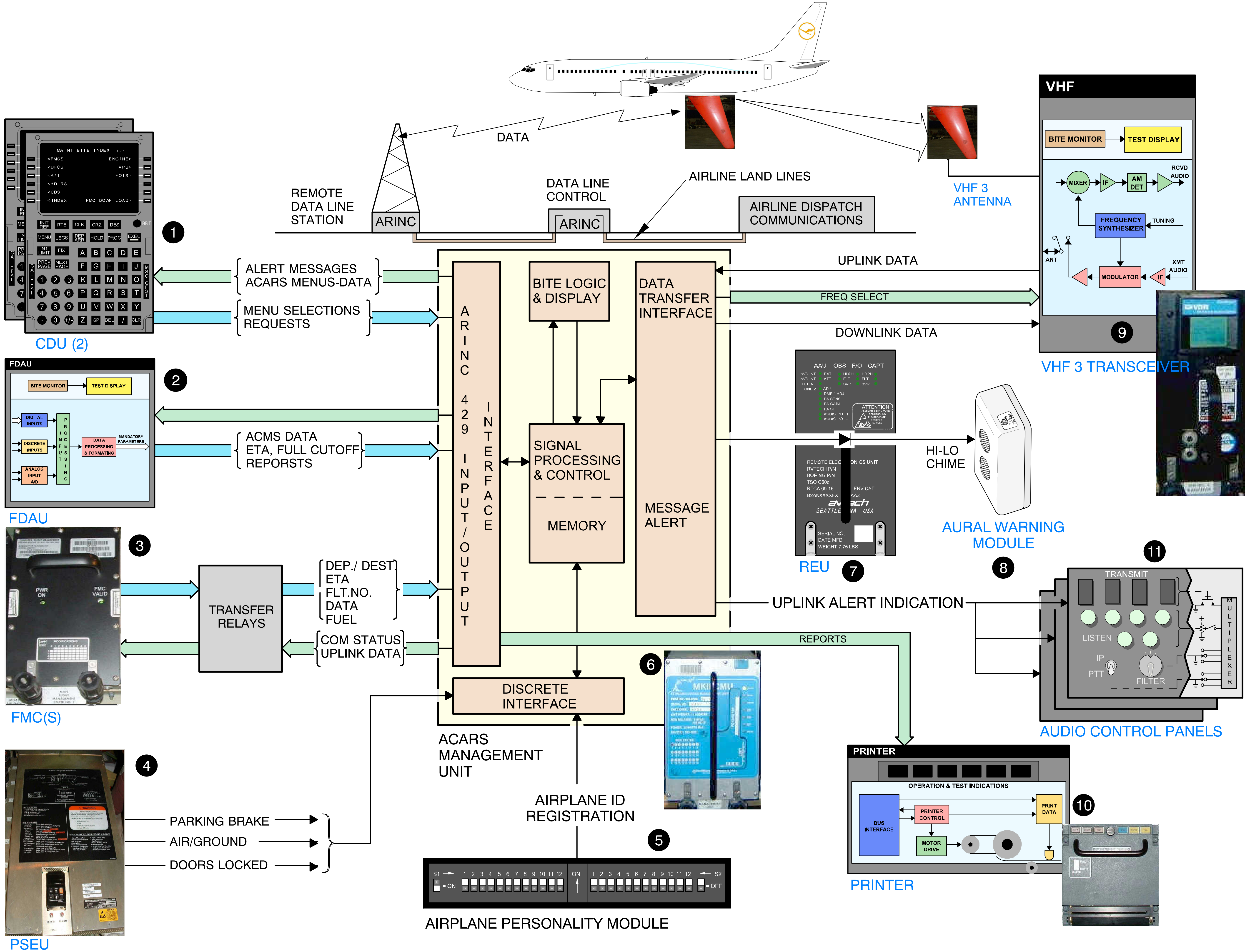
VHF transceiver to transmit and receive data from the ground.

10 Printer

Printer to print ACARS reports and messages.

11 Audio Control Panels

Visual Indication for received ACARS messages.


DATA
REMOTE DATA LINE STATION
ARINC
DATA LINE CONTROL
ARINC
AIRLINE LAND LINES
AIRLINE DISPATCH COMMUNICATIONS
VHF 3 ANTENNA
VHF
BITE MONITOR
TEST DISPLAY
MIXER
IF
AM DET
RCVD AUDIO
FREQUENCY SYNTHESIZER
TUNING
ANT
MODULATOR
XMT AUDIO
VHF 3 TRANSCEIVER
CDU (2)
ALERT MESSAGES
ACARS MENUS-DATA
MENU SELECTIONS
REQUESTS
UPLINK DATA
FREQ SELECT
DOWNLINK DATA
ARINC 429 INPUT/OUTPUT
INTERFACE
BITE LOGIC & DISPLAY
DATA TRANSFER INTERFACE
SIGNAL PROCESSING & CONTROL
MEMORY
MESSAGE ALERT
FDAU
DIGITAL INPUTS
DISCRETE INPUTS
ANALOG INPUT A/D
INPUT PROCESSING
DATA PROCESSING & FORMATTING
MANDATORY PARAMETERS
ACMS DATA
ETA, FULL CUTOFF
REPORTS
HI-LO CHIME
REU
AURAL WARNING MODULE
FMC(S)
TRANSFER RELAYS
DEP./ DEST.
ETA
FLT.NO.
DATA
FUEL
COM STATUS
UPLINK DATA
UPLINK ALERT INDICATION
REPORTS
TRANSMIT
LISTEN
IP
PTT
FILTER
MULTIPLEXER
AUDIO CONTROL PANELS
DISCRETE INTERFACE
ACARS MANAGEMENT UNIT
PSEU
PARKING BRAKE
AIR/GROUND
DOORS LOCKED
AIRPLANE ID REGISTRATION
AIRPLANE PERSONALITY MODULE
PRINTER
OPERATION & TEST INDICATIONS
BUS INTERFACE
PRINTER CONTROL
PRINT DATA
MOTOR DRIVE
PRINTER
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Reference to Figure 15 Emergency Locator Transmitter

23-24 EMERGENCY LOCATOR TRANSMITTER

GENERAL

The ELT (**E**mergency **L**ocator **T**ransmitter) system has these components: Control panel, Programming and position interface unit, Transmitter and Antenna.

The control panel has a switch that you use to start the ELT manually. It also has a light to show you that the ELT is in operation.

The ELT transmitter has two transmitter sections: One transmitter sends a swept tone on the VHF and UHF emergency channels (121.5 and 243.0 MHz). The other transmitter sends digital data every 50 seconds on the 406 MHz channel. The antenna sends the 121.5/243.0 MHz and 406 MHz transmit signals.

1 ELT

The ELT supplies these signals:

- ELT ON LIGHT
- RF OUT(2)

The ELT ON and LIGHT signals go to the ELT control panel. The ELT has two transmitter sections, one for the 121.5/243.0 MHz signal, and one for the 406 MHz signal. The two transmitter sections send the RF emergency signals to the ELT antenna on different transmission lines. The ELT receives these signals, EXT ON, RESET 1 and RESET 2. The EXT ON signal from the control panel manually starts the transmitter. The reset signals stop the transmitter if it accidentally starts. A G-switch enable jumper wire arms the ELT when the unit is securely installed.

2 ELT Control Panel

The ELT control panel sends an Manual ON signal to the ELT to start the transmitter. It also sends reset signals to stop the transmitter if it accidentally starts. The control panel gets the LIGHT signal from the ELT to control the ELT light. It also gets an ELT ON signal to turn on the master caution.

3 ELT Antenna

The ELT antenna sends the emergency signals on the VHF and UHF frequencies.

4 Reset

The RESET 1 and RESET 2 inputs from the control panel let you turn off the transmitter when it was on accidently. These inputs turn off the transmitter when you put the control panel switch from ARM to ON and immediately back to ARM. You can also turn off the transmitter when you put the ELT front panel switch from OFF to ON and immediately back to OFF.

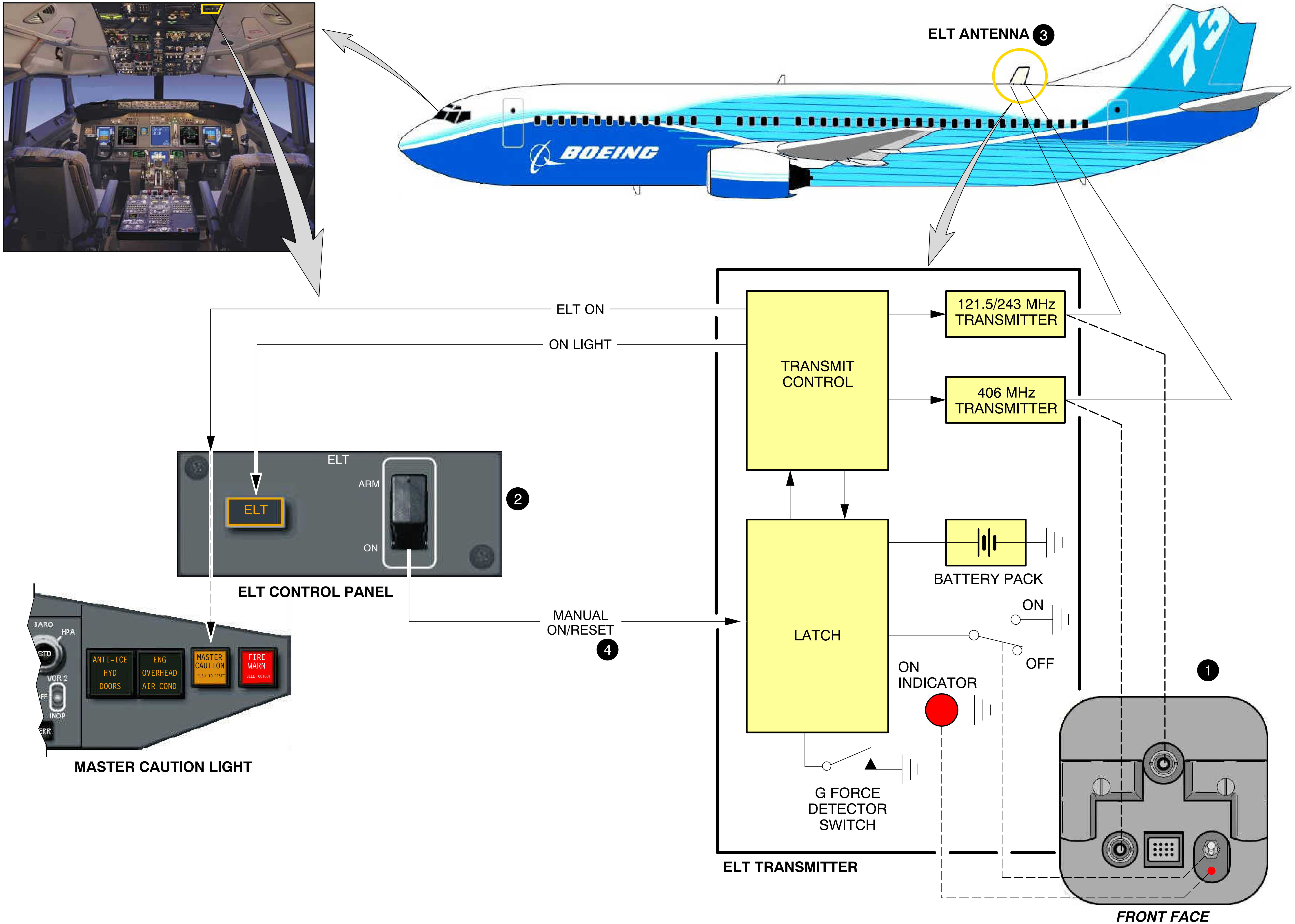


Figure 15 Emergency Locator Transmitter

Reference to Figure 16 SELCAL System Operation

23-20 DATA TRANSMISSION & AUTOMATIC CALLING

GENERAL

The selective calling (SELCAL) system supplies the flight crew with indications of calls that come in from the a ground station. Each airplane has a different SELCAL code. A ground station transmits this code to communicate with an airplane. When the airplane receives its SELCAL code, flight compartment indications come on to tell the flight crew.
It is not necessary for the pilots to continuously monitor company communications channels. Airline radio networks supply communication between ground stations and airplanes. For SELCAL operation, each airplane has a different four-letter code. Each letter in the code equals a different audio tone.
The ground stations send the applicable tones to call an airplane.

1 HF And VHF Transceivers

The HF and VHF transceivers receive the SELCAL signal and send it to the SELCAL decoder.

2 SELCAL Coding Switch

A SELCAL coding switch gives the airplane its SELCAL code. It supplies the code to the SELCAL decoder. The SELCAL coding switch is behind the SELCAL decoder on the E-4 rack.

3 SELCAL Decoder Unit

The SELCAL decoder unit monitors for audio tones. If the tones are the same as the code, the decoder sends a signal to the control panel. The decoder also sends a ground to the SELCAL aural warning relay.

4 SELCAL Aural Warning Relay

This relay gives power to the REU to send a signal to the aural warning unit. The SELCAL decoder is on the E-4 rack in the electronic equipment compartment.

5 SELCAL Control Panel/Audio Control Panel

The SELCAL control panel / Audio Control Panel receives the signals that come from the SELCAL decoder unit. The alert light comes on for the transceiver that receives the call. Push the alert light switch to reset the decoder channel.

6 Remote Electronics Unit (REU)

The REU receives a 28 V discrete voltage and sends a signal to the aural warning unit.

7 Aural Warning Unit

The aural warning unit gets a discrete signal and generates a high/low chime tone.

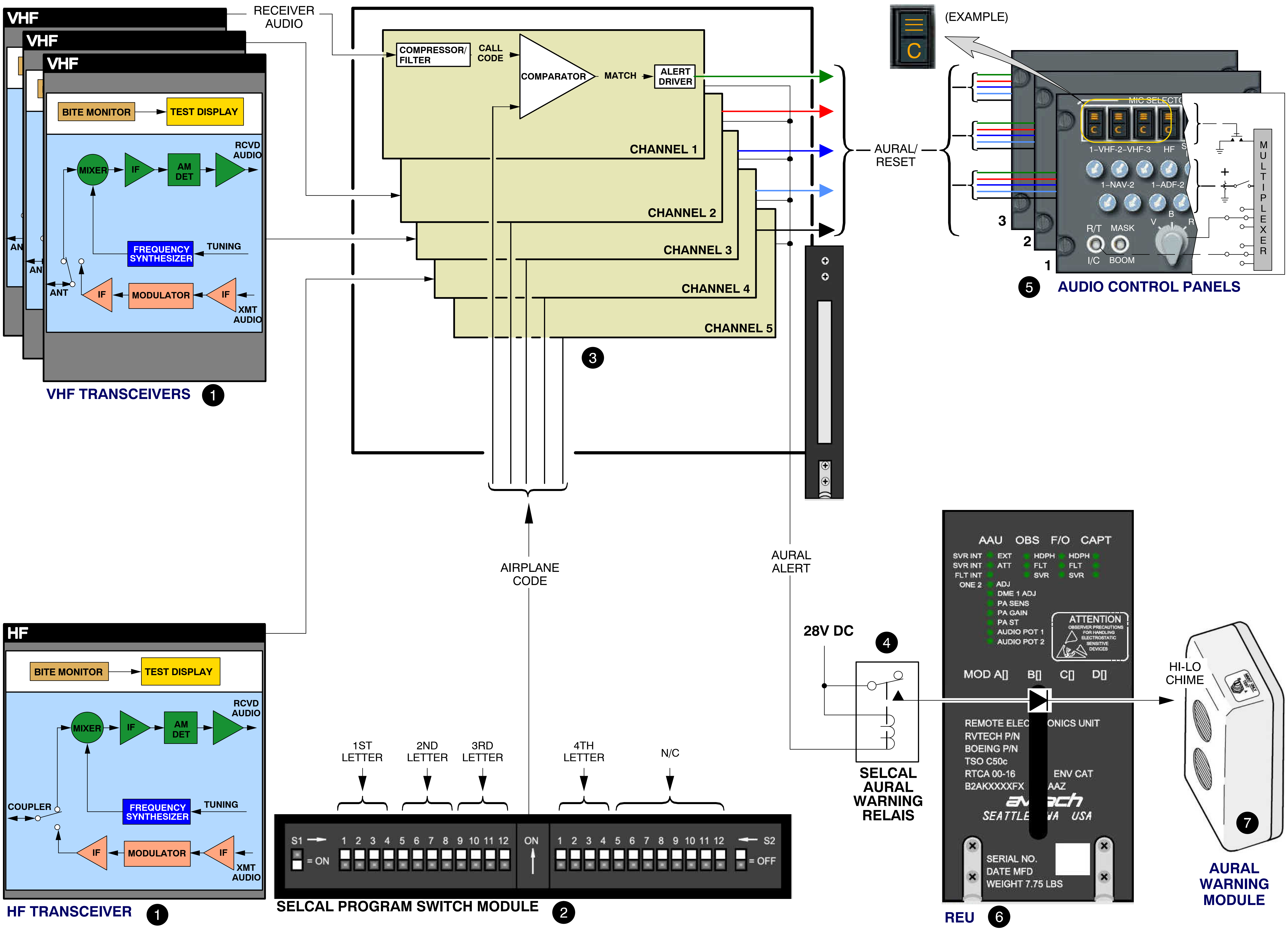


Figure 16 SELCAL System Operation

Reference to Figure 17 Voice Recorder (VR) System

23-71 AUDIO&VIDEO MONITORING

GENERAL

The voice recorder unit makes a continuous record of flight crew communication and flight compartment sounds. It erases the communication data automatically so that the memory stores only recent audio .It keeps the last 120 minutes of communication data in memory. The voice recorder unit receives audio from the REU and the area microphone. The area microphone is in the cockpit voice recorder panel.

1 Voice Recorder Switch

The voice recorder gets 115v ac from either the time delay relay or the voice recorder switch. When the voice recorder switch is put to ON, the switch applies power to the voice recorder.
A latching relay holds the switch in the ON position. This keeps the voice recorder power on for the pre-flight checks.
When an engine starts, the latching relay opens. This returns the voice recorder switch to AUTO. At the same time, the time delay relay energizes.
The time delay relay keeps 115v ac to the voice recorder. When the engines are shut down, the time delay relay keeps the voice recorder on for an additional 5 minutes. This gives time for post-flight checks.

2 Cockpit Voice Recorder Panel

The cockpit voice recorder panel sends these signals:

- Erase discrete to the voice recorder
- Test discrete to the voice recorder
- Area audio to the channel 4 input of the voice recorder.

3 Remote Electronics Unit

The REU (**R**emote **E**lectronics **U**nit) sends these signals to the voice recorder unit:

- Observer's audio,
- F/O (**F**irst **O**fficer's) audio,
- Captain's audio.

4 Clock

Clock data from the captain's clock goes to the voice recorder on an ARINC 429 data bus.

5 PSEU

Park and Squat Ground Sensing Relay
The park and squat ground sensing relay gets Power from the voice recorder unit. This relay closes when the parking brake is set and the airplane is on the ground. When it is closed, the relay sends Power to the erase switch on the cockpit voice recorder panel.

6 Voice Recorder Unit

The voice recorder unit sends 30v dc to the park and squat ground sensing relay. It also sends these signals to the cockpit voice recorder panel:

- Test indication to the monitor indicator
- Monitor/test audio to the headphone jack.

7 ULD

The **U**nderwater **L**ocating **D**evice (ULD) is an ultrasonic beacon. It makes the CVR (**C**ockpit **V**oice **R**ecorder) easier to find if it is under water.

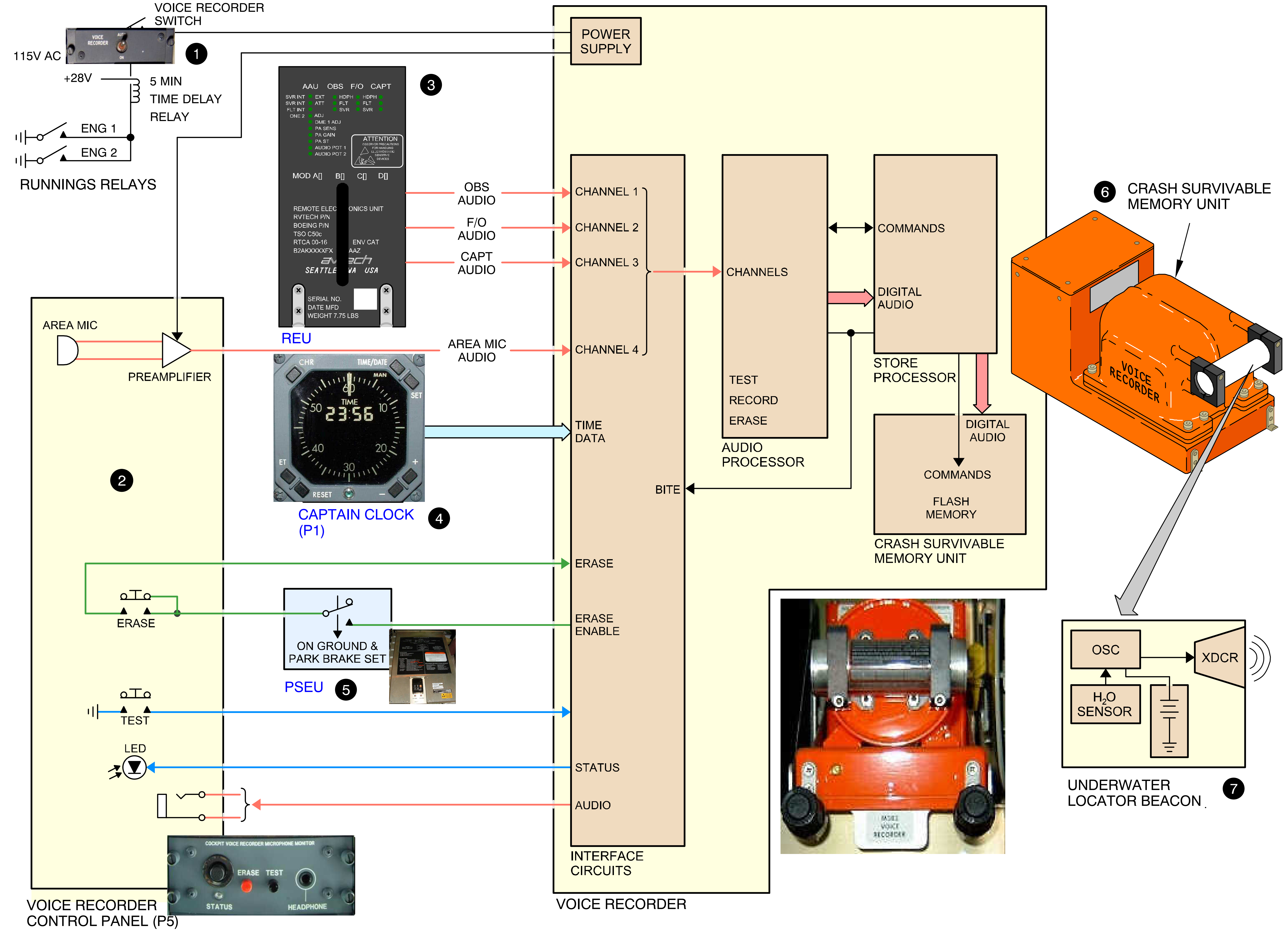


Figure 17 Voice Recorder (VR) System

Reference to Figure 18 Passenger Entertainment System/Audio-Power Interface

23-34 PES/ AUDIO

GENERAL

The **P**assenger **E**ntertainment **S**ystem -audio (PES-audio) sends recorded entertainment audio and passenger address audio to each passenger seat. Each passenger can make a selection to hear one of many available audio channels.

1 IFE / Pass Seat Switch

The IFE / PASS SEAT Switch, is used to shut down and remove power from the cabin entertainment system. If you place this switch to the position OFF, power is removed from Audio Player and Multiplexer, SEBs (**S**eat **E**lectronic **B**oxes), PCUs (**P**assenger **C**ontrol **U**nits), VSCU (**V**ideo **S**ystem **C**ontrol **U**nit) , VDUS (**V**ideo **D**istribution **U**nits) , Monitors, Digital Interface Unit (Airshow-unit) and Flight Deck Printer.

2 Attendant Control Switch

Attendants use the forward attendant panel to control power to

- the audio entertainment player
- the audio multiplexer
- to all Seat Electronic Boxes in the passenger cabin

3 R 918 IFE/Pass Seat CTRL RLY

This Relay is controlled by the IFE / PASS SEAT switch on the P5-13 Panel. When switched on, this relay closes an activates R 916 to route 115V AC power to the R 660.

4 R 916 XFER BUS 1 IFE/Pass Seat Outlet

This relay is activated by relay R 918, and closes, so that the power can reach relay R 660 for PES Entertainment. In case of overcurrent condition this relay will be loadshedded by the BPCU.

5 R 917 XFER BUS 2 IFE/Pass Seat Outlet

For description see R 916.

6 R 660

This relay is closed by the FWD Attendant panel switch. It interrupts the 115V AC power from the IFE/PASS Seat switch to the passenger entertainment system.

7 Audio Multiplexer

The audio multiplexer changes the analog signals to digital signals. 115V AC power from ife pass seat switch powers the Audio Mux.

8 SEB

The signal goes through the first SEB on to the next SEB. The signal goes from SEB to SEB all the way down the column. There is a termination plug on the last seat electronics box in each column. The SEB chooses the selected channel from the digital signal. The SEB converts the digital signal to an audio signal. The SEB sends the audio signal to the passenger control unit. 115V AC power from IFE Pass Seat Switch is routed from SEB to SEB.

9 PCU

The passenger sets the channel on the passenger control unit. The passenger control unit sends the channel selection to the seat electronics box. 5.6 V DC power from each SEB is powering 3 PCUs.

10 Audio Entertainment Player

The audio entertainment player sends 16 audio signals to the audio multiplexer.
The video system control unit sends audio from the video system to the audio multiplexer. The video system control unit can send audio for three video programs.
Each video program can have two channels of audio.
It is powered by 115 V AC Power via R660.

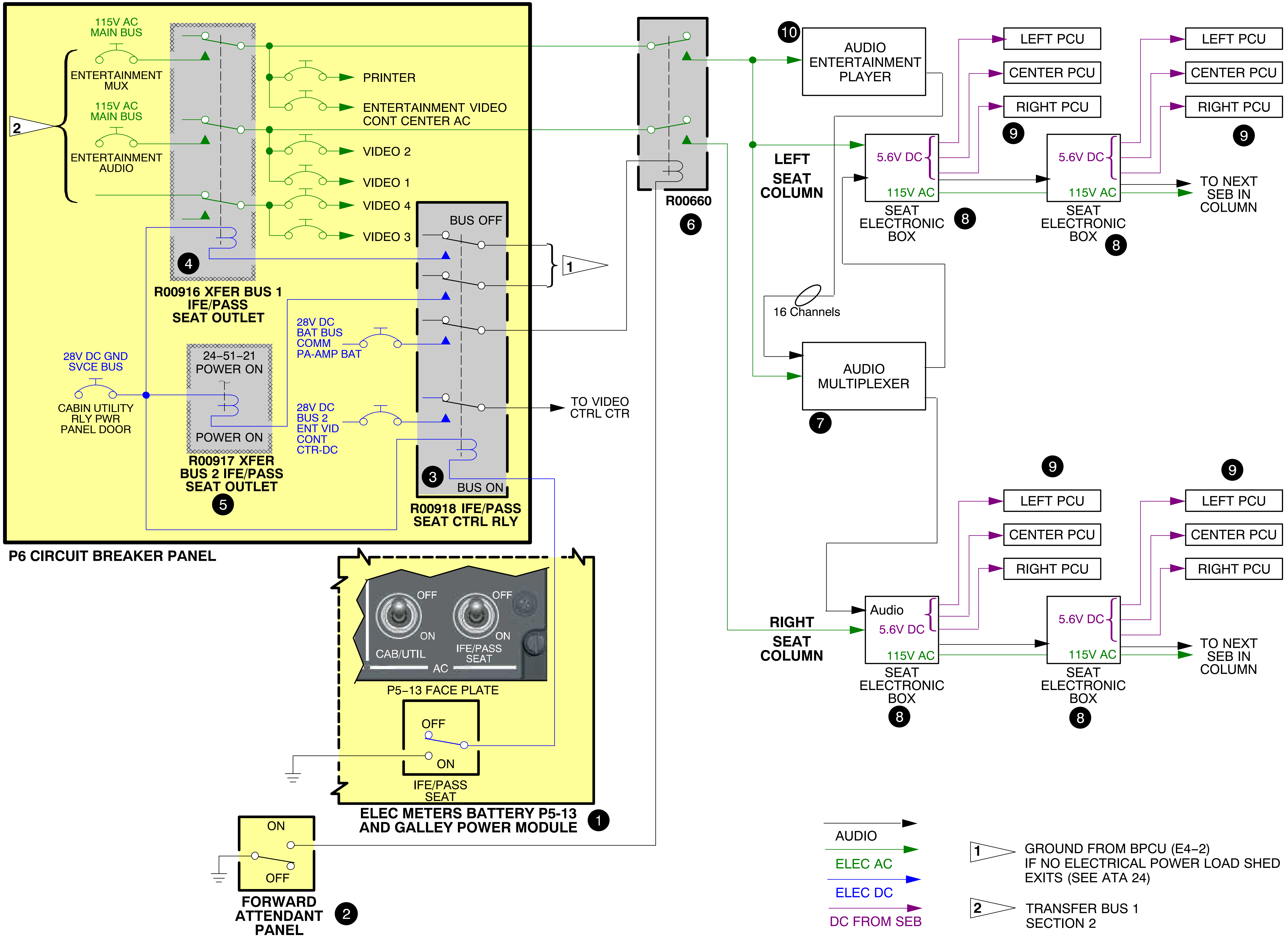


Figure 18 Passenger Entertainment System/Audio-Power Interface

Reference to Figure 19 PES/VIDEO Interface

23-32 PES/VIDEO

GENERAL

The PES-video (**P**assenger **E**ntertainment **S**ystem-video) provides video programs for the passengers. The video programs have video and audio. The video goes to monitors throughout the cabin. The audio goes through the passenger entertainment system-audio (PES-audio). Passengers receive this audio through headsets attached to the passenger service units in the seats. The audio can go through the passenger address system. Passengers receive this audio through speakers in the passenger service units.

1 FMC

Provides Route Data for the Airshow.

2 ADIRU

Provides Attitude Data for the Airshow.

3 Data Loader

Upload Data for the Airshow Unit DIU.

4 PSEU

A signal from the PSEU is used for flight leg switching in the video system. It shows the video system when the airplane is in air to start automatic passenger entertainment.

5 Oxygen Indication Relay

A signal from the passenger oxygen system stops the video program when passenger oxygen masks deploy.

6 Video Tape Reproducer

Video tapes provide programs for the passengers. You put the video tapes into the VTR (**V**ideo **T**ape **R**eproducers).

7 PA

Gives discrete signal during PA announcements and stops video programs.

8 DIU

The digital interface unit provides Airshow flight data for the passengers. The DIU sends video signals to the video system control unit.

9 VSCU

The video system control unit sends control signals and three video signals to the video distribution units. The video system control unit tells each video distribution unit when to turn on the monitors and which video signal to send to the monitors. The video system control unit sends the audio from the video program to the passenger entertainment system audio. The PES-audio distributes the audio to the passenger control units in the passenger seats. When you want the audio to play on the speakers in the cabin, the video system control unit sends the audio to the passenger address system. The passenger address system distributes the audio to the speakers in the cabin when a video program plays.

10 Meter Panel

A switch, called IFE/PASS SEAT, is used to remove power from the whole cabin entertainment system. The VSCU turns on the VIDEO ON light in the flight compartment.

11 Audio MUX

Provides audio channels for each PCU for the video/audio system.

12 PA AMP

Audio output via cabin speakers selectable.

13 VDU

The video distribution units receive a signal from the video system control unit to turn on the video monitors. When the video distribution units receive the signal, they supply 115v ac power to the video monitors.

14 Monitors

The video monitors are in the ceiling below the hattracks. There are two monitors at each station. For each station, one monitor is on the left side and one monitor is on the right side. The video distribution units are above the ceiling.

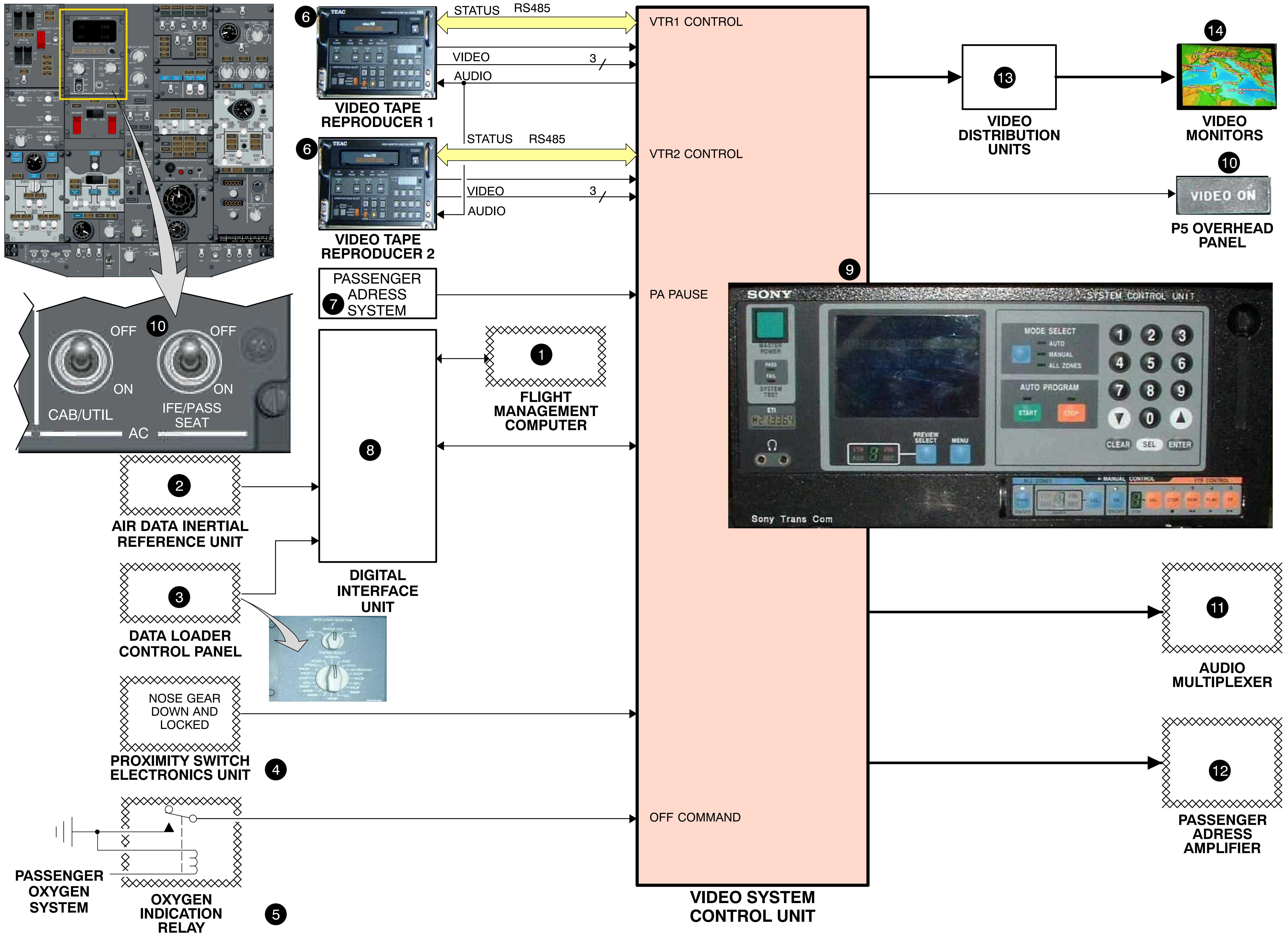


Figure 19 PES/VIDEO Interface

Reference to Figure 20 Cockpit Door Surveillance & Flight Deck Entry Video Surveillance System

23−70 FDEVSS (FLIGHT DECK ENTRY VIDEO SURVEILLANCE SYSTEM)

23−75 CDSS (COCKPIT SURVEILLANCE SYSTEM)

GENERAL

The video surveillance system is designed to augment aircraft security by providing a secured unobstructed view of the cockpit entry area including identification of persons requesting entry when the cockpit door is closed and locked during flight or ground operations. The system uses three cameras linked to a LCD Monitor mounted in the cockpit, which is accessible to either pilot's position. The cameras are positioned above the flight deck entry door and on either side of the entry corridor to cover the entire door area. The system also includes IR (**I**nfra**R**ed) illuminators enabling the area to be viewed even when the cabin lights are extinguished. The system consists of three cameras, three IR illuminators (paired to each camera), three camera control units, a video switch unit, a control panel, and a LCD monitor. Primary power for the system is 28 volts dc supplied from the 28 vdc bus 2 through a 2A circuit breaker labeled FLIGHTVU SYSTEM.

VIDEO OPERATION

28V DC power from dc−bus 2 is available to the system. The system is not powered until the power switch on the control panel is set to the ON position. When set to the ON position, electrical power is routed through the Video Switch Unit to the LCD Monitor and each CCU (**C**amera **C**ontrol **U**nit). The LCD Monitor will come on and display the selected video source in a few moments. Each CCU will supply elec. power to the respective camera. Each CCU will begin to feed video back to the Video Switch Unit. The Brightness and Contrast of the LCD Monitor can be adjusted using the two control knobs on the control panel. Video source selection is accomplished by using camera select knob on the control panel (LEFT, DOOR, or RIGHT).

1 Camera

Power is supplied to the camera from the Camera Control Unit which converts the 28V DC aircraft power to 9V DC.

2 IR Illuminators

An Infrared (IR) Illuminator is utilized for each area to be viewed. The IR illuminator is powered from the aircraft 28V DC and provides invisible illumination so that the cameras can detect and present a clear image of the areas under surveillance in low or no light conditions.

3 Camera Control Unit

The Camera Control Unit is used to interface the aircraft 28V DC power and video signal to and from the camera. The Camera Control Unit must be mounted within four meters of the system camera being controlled. There is one Camera Control unit required for each system camera.

4 Video Switch Unit

The Video Switch Unit is the core part of the video system. This unit mounts in the lower equipment bay. Power is converted from 28V DC aircraft power and is supplied at 12V DC to the LCD monitor. System power is switched on and off through this unit with control from the ON/OFF switch on the control panel. A red LED is mounted on the front panel of the Video Switching Unit and illuminates when 28V DC is supplied to the unit.

5 Control Panel

System control is through the Control Panel. The panel overlay is connected to the existing aircraft panel lighting for visibility at low light or nighttime operation.
OFF/ON: Power for the system is routed from the relevant circuit breaker through the Video Switch Unit and controlled by this switch, allowing for total power isolation of the system. LCD Monitor The LCD Monitor is used to display images from the selected camera. The monitor uses a 50 ohm balanced video input from the Video Switch Unit.
Monitor power is supplied at 12V DC from the Video Switch Unit.

6 LCD Monitor

The LCD Monitor is used to display images from the selected camera. The monitor uses a 50 ohm balanced video input from the Video Switch Unit.
Monitor power is supplied at 12V DC from the Video Switch Uni

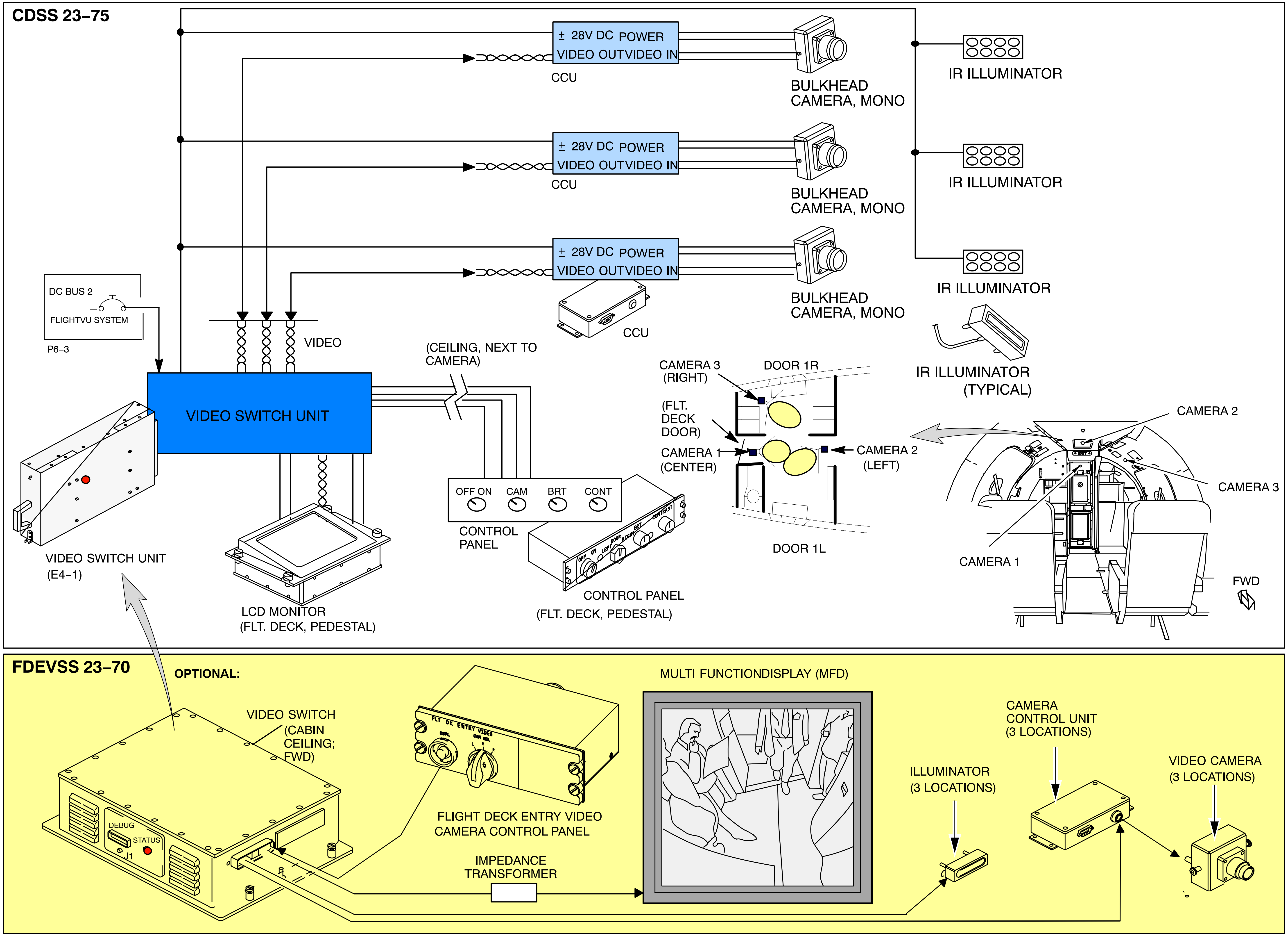


Figure 20 Cockpit Door Surveillance & Flight Deck Entry Video Surveillance System

Reference to Figure 21 Electrical Power General

ATA 24 ELECTRICAL POWER

24-00 POWER AND CONTROL: GENERAL

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The electrical power system makes and supplies AC and DC power to airplane. The system has automatic and manual controls and protection. A standby AC and DC system gives normal and emergency power.

AC Power

The electrical power system has four main AC power sources and one standby power source.
These are the main AC power sources:

- Left integrated drive generator (IDG 1)
- Right integrated drive generator (IDG 2)
- APU starter-generator
- External power

The AC power sources supply a 3 phase,115/200 volts (nominal) at 400 Hz. The AC power system design prevents two sources to the same load at the same time.

The static inverter supplies a one phase, 115v ac output to the AC standby bus if the AC power sources fail.

DC Power

The DC generation system supplies a nominal 28v dc to different loads. The power source for the DC system is usually the AC system. The battery supplies power if the AC system is not available.

The DC generation system has these components:

- Batteries (2)
- Battery chargers (2)
- Transformer rectifier units (3)

The DC generation system supplies a nominal 28v dc to different loads. The batteries supply power if the AC system is not available.

1 Integrated Drive Generators

The IDGs are the normal source of AC power generation in flight. The IDG is an assembly that has a hydromechanical CSD (**C**onstant **S**peed **D**rive) section and an oil-cooled brushless AC generator section. There are two IDGs on the airplane. Each supplies 115/200v ac, 400 Hz power. The IDG can supply up to 90 KVA.

2 APU Starter-Generator

The APU starter-generator has two functions. First, the starter-generator makes AC power for ground operations. The starter-generator can supply electrical power during flight as backup for the IDGs.

The starter-generator also starts the APU. It uses AC power from the SCU (**S**tart **C**onverter **U**nit) to turn the APU during the start sequence.

3 External Power

External power is the normal source of AC power for the airplane electrical system when the airplane is on the ground. The external power panel has a receptacle for AC external power connection.

4 Start Converter Unit

The SCU operates with the AGCU (APU **G**enerator **C**ontrol **U**nit) to control and regulate APU starter-generator power. The SCU also makes the starter-generator function like a motor to turn the APU during starting.

5 Bus Power Control Unit

The BPCU controls and monitors the use of external power. The BPCU protects the airplane from external power whose quality is out of limits.

6 Generator Control Units

The GCUs monitor the system to control and protect the IDGs. Each GCU (**G**enerator **C**ontrol **U**nit) has these functions:

- Control a GCB (**G**enerator **C**ontrol **B**reaker) and a BTB (Bus Tie Breaker)
- Supply/control excitation to an IDG generator
- Protect the electrical system and an IDG from electrical parameters not in limits
- Control electrical system indication on the P5-5 and P5-4 modules
- Give built-in-test for fault isolation

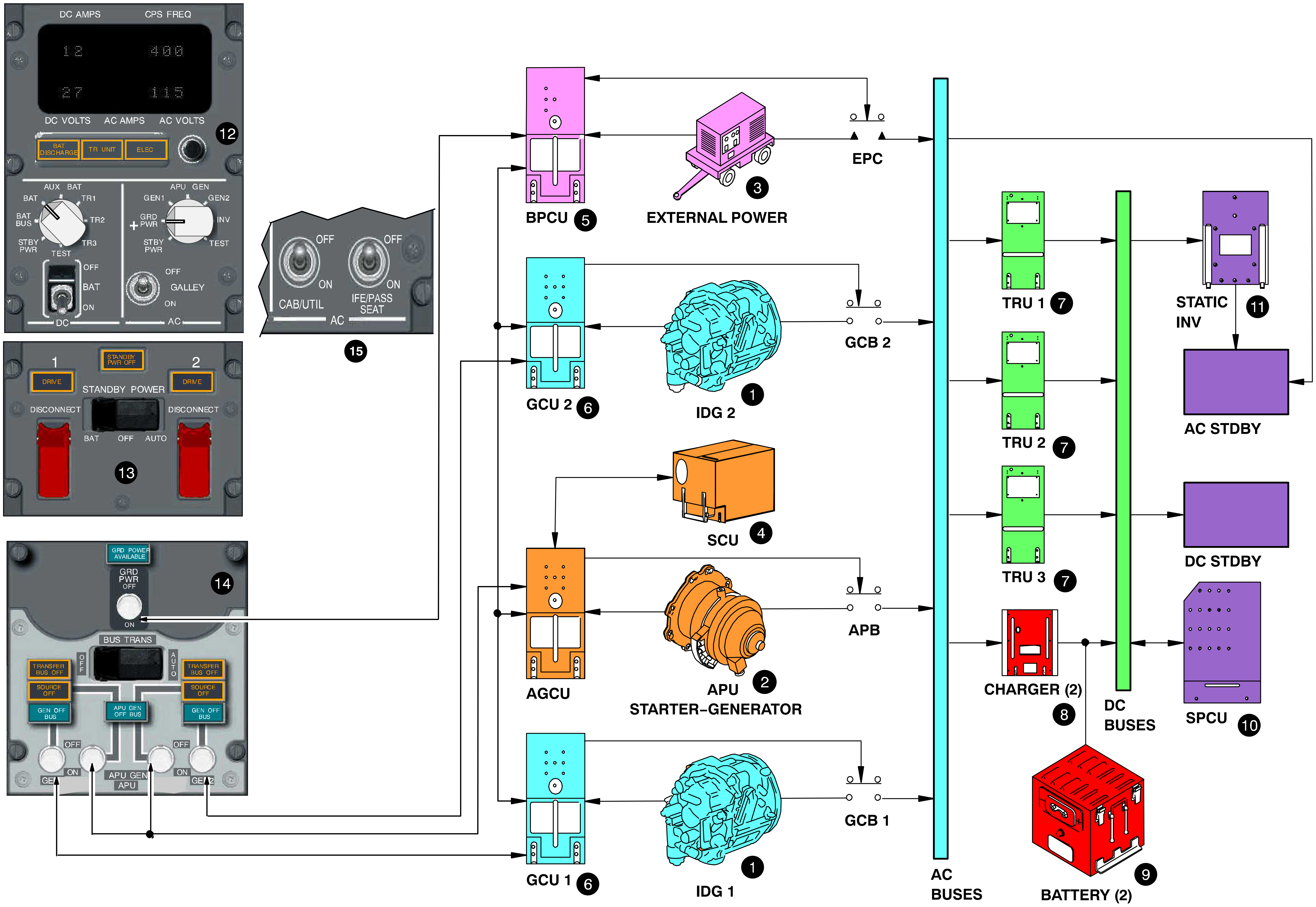


Figure 21 Electrical Power General

Reference to Figure 22 Electrical Power General (Cont.)

8 Battery Charger (Main and Auxilliary)

The main battery charger gives a DC voltage output to charge their respective battery. Each charger operates like a TRU after the battery gets to full charge. The main battery charger sends a constant DC voltage to the battery and the hot and switched hot battery buses.

9 Battery (Main and Auxilliary)

Each battery is a 48 ampere−hour, nominal 24v dc power source. The main battery supplies power for APU starting and is a standby power source if all other power supplies do not operate. The auxiliary battery helps the main battery to supply standby power only.

10 Standby Power Control Unit

The SPCU gives automatic and manual control of the battery and standby buses. The SPCU monitors the standby power system for faults. The SPCU sends the fault data to the electrical meters, battery, and galley power module where the ELEC light comes on.

11 Static Inverter

The static inverter is the backup power source for the AC standby bus. The static inverter uses DC power to give 115 volts, 400 Hz, single phase AC power to standby loads. A static inverter failure causes the amber ELEC light to come on.

12 Electrical Meters, Battery and Galley Power Module

The electrical meters, battery and galley power module is used for these functions:

- See electrical power parameters for AC and DC components or buses.
- Connect battery power to electrical buses with the battery switch.
- Supply and remove power to the galleys with the galley switch.

The module also has these BITE functions:

- Supplies DC and standby power system failure indication.
- Monitors the dc and standby power and saves fault messages in memory.
- Shows fault messages on the LED alphanumeric display.

13 Generator Drive and Standby Power Module

The generator drive and standby power module has these indications and manual controls:

- IDG low oil pressure indication (DRIVE lights)
- Indication that the battery bus or either standby bus do not have power (STANDBY PWR OFF light)
- Generator drive disconnect switches
- Standby power switch.

14 AC Systems, Generator and APU Module

The AC systems, generator and APU module has the control switches to switch the different AC power sources ON or OFF. The blue Available light monitors the availibility and quality of the External AC power source. The blue Gen Off Bus Lights monitor the GB positions from IDGs and APU Generator. The amber lights shows a faulty power supply or an abnormal power source configuration on the AC busses.

15 CAB/UTIL and IFE/PASS Seat Switch

These Switches are optional. With the CAB/UTIL switch you can switch on and off all Cabin and Utillity Busses, like the Galley Busses and Main Busses.

With the IFE/PASS Seat switch you direct Power to the complete Pass Entertainment System and the Cockpit Printer.

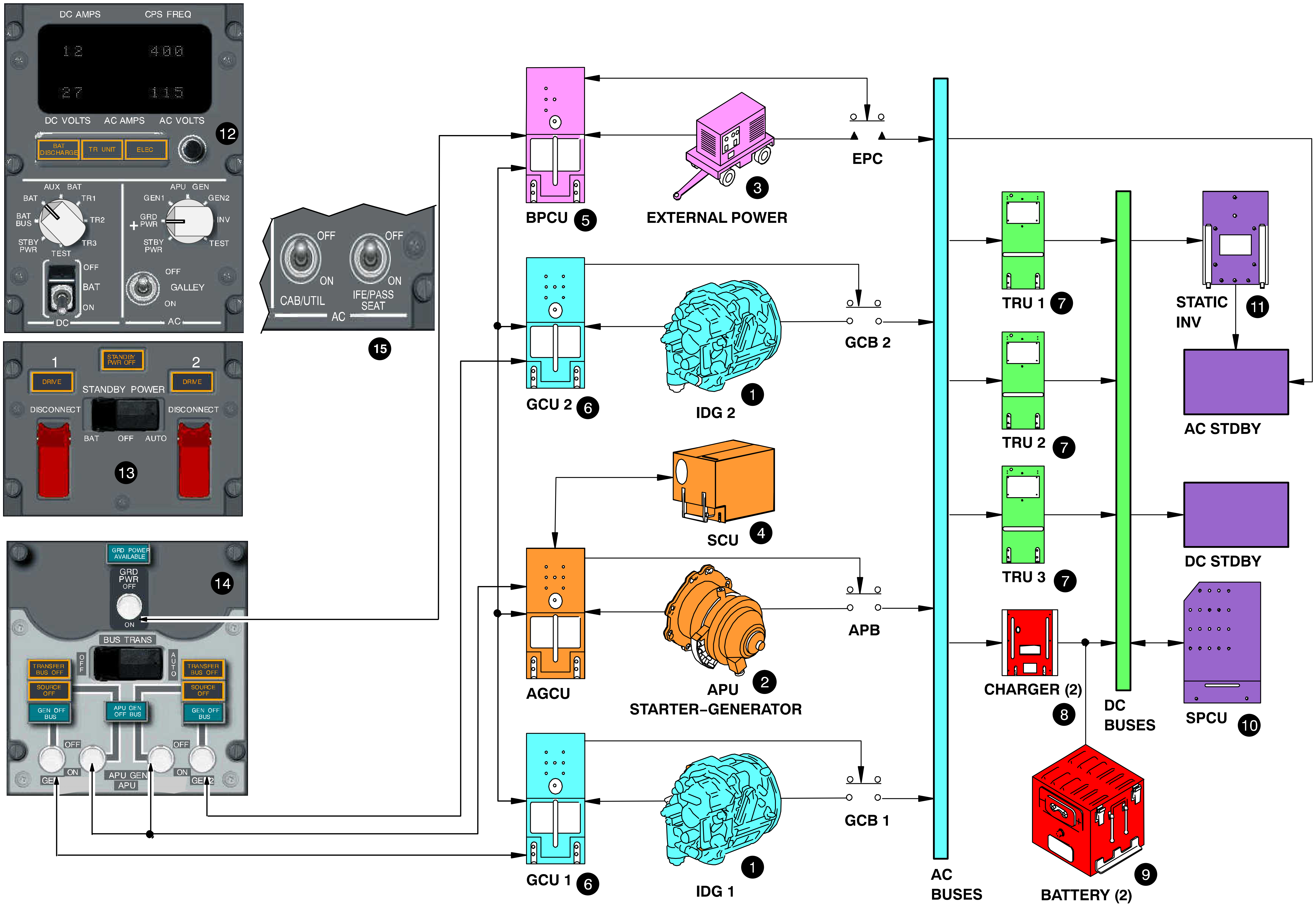


Figure 22 Electrical Power General (Cont.)

Reference to Figure 23 Electrical Power General

24−00 GENERAL

GENERAL

The AC part of the electrical system has separate left and right systems (nonparallel).This means that two power sources never supply power to the same AC transfer bus at the same time.
The left and right parts of the AC systems connect if only one power supply is available

1 Power Distribution Panels

The PDP 1 and 2 have these components:

AC transfer bus 1, Ground service bus 1, DC bus 1, GCB 1, APB, BTB 1, AC transfer bus 2, Ground service bus 2, DC bus 2,GCB 2, EPC and BTB 2.
There are 4 red lights on the forward and aft face of the each panel. These lights come on to warn you that electrical power is active inside the panel.

2 GCU 1/2 And APU

The GCUs control and monitor power quality. With flight compartment switch position input and good power, the GCU supplies a signal to close the breaker.
The GCUs and BPCU communicate with each other.The AGCU operates with the SCU to maintain good APU generator power.The AGCU monitors power quality and is the same part as a GCU.
The AGCU uses a voltage regulator in the SCU to control starter−generator output.

3 APU SCU

The SCU (**S**tart **C**onverter **U**nit) controls the APU generator voltage. The SCU also makes the starter−generator function like a motor to turn the APU during starting.

4 BPCU

The BPCU controls the use of external power and monitors breaker positions for the electrical system.

The BPCU works with the GCUs to control BTB (**B**us **T**ie **B**reaker) position. If a power overload takes place, the BPCU opens the galley and main bus load shed relays.

5 SPCU

The SPCU monitors the position of the battery and standby power switches. It also monitors AC, DC and battery buses. The SPCU monitors and sends standby power system controls and relay failure data to the P5−13 module. The SPCU has circuit breakers on its front panel.

6 TRU 1/2/3

The three TRUs take 115v ac, decrease the voltage (transforms), and rectify it to a nominal 28v dc.

7 Battery

Each battery is a 48 ampere−hour power source.The main battery supplies power for APU starting and is a standby power source if all other power supplies do not operate.The auxiliary battery helps the main battery supply standby power only.

8 Battery Charger

The main battery charger and auxiliary battery charger give a DC voltage output to charge their respective battery.
Each charger operates like a TRU after the battery gets to full charge.

9 Static Inverter

The static inverter uses DC power to give 115 volts, 400 Hz, single phase AC power to standby loads.
The static inverter has input power whenever the BAT switch is in the ON position or the standby power switch is in the BAT position

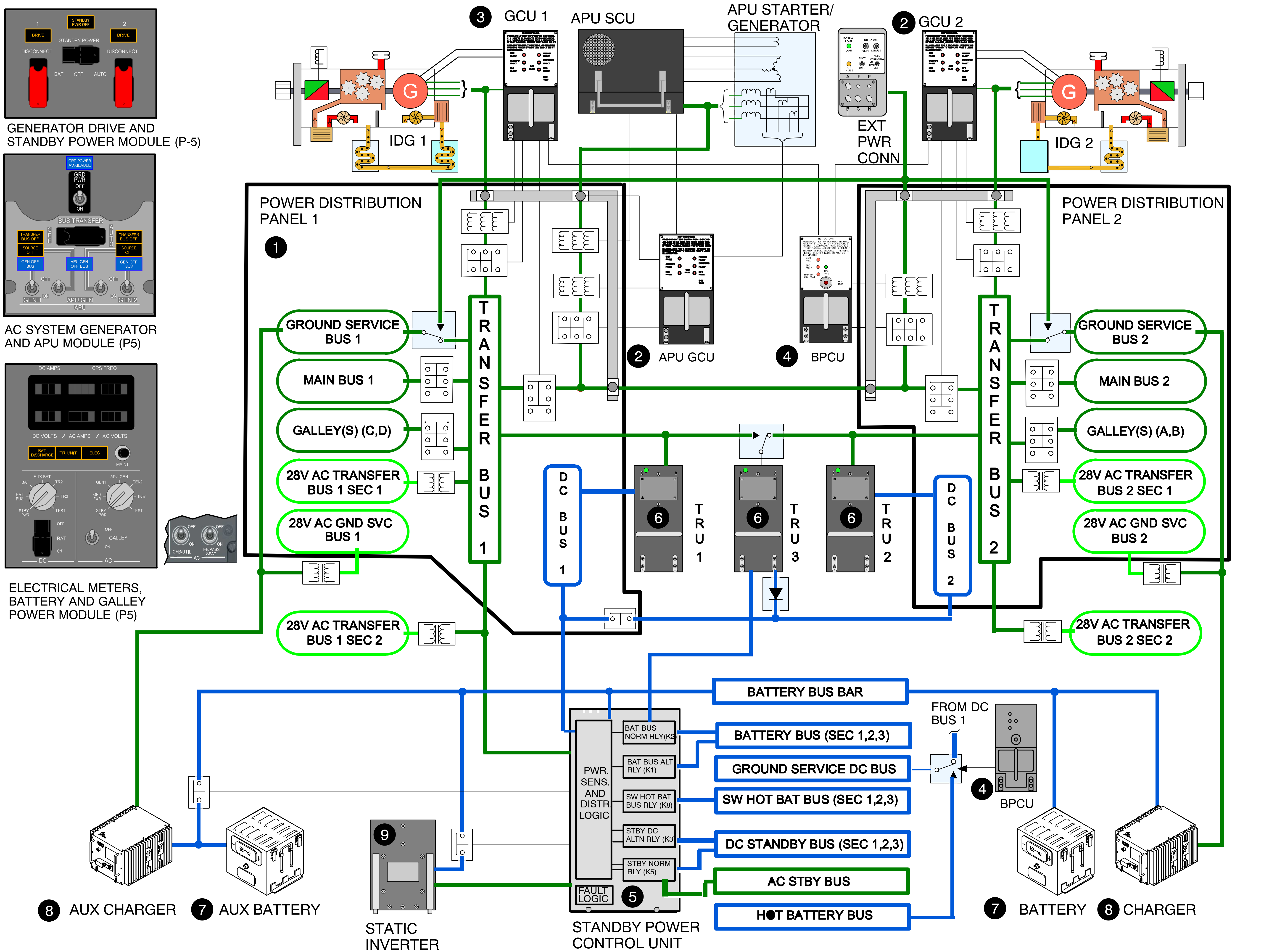


Figure 23 Electrical Power General

Reference to Figure 24 Electrical Power Schematic

24-00 GENERAL

GENERAL

The GCUs (**G**enerator **C**ontrol **U**nits) and the BPCU (**B**us **P**ower **C**ontrol **U**nit) operate together to control AC power. A sequence of command signals and breaker position signals must happen before an electrical power source can supply power to a transfer bus. The BPCU monitors the EPC (**E**xternal **P**ower **C**ontactor), GCB, and BTB positions by auxiliary contacts on each breaker. The BPCU monitors bus transfer switch position for BTB control.
The BTB operation is automatic when the bus transfer switch is in the AUTO position

1 GB

The GCU sends a close/open command to the related GCB after the BPCU sees all applicable breakers open/close.

2 AGB

The AGCU signals the APB to close/open after the BPCU sees all applicable breakers open/close.

3 BTB

The GCU sends a close command to the related BTB after the BPCU sees all applicable breakers open/close.

4 EPC

The BPCU sends a close/open command to the related EPC.

5 Battery Bus Alternate Relay (K1)

The relay energizes when Battery switch is in the ON position, TRU 3 has no power or when the standby power switch is put to the BAT position.

6 Battery Bus Normal Relay (K2)

The battery bus normal relay (K2) energizes to let the battery bus receive power from TRU 3.

7 Stby Dc Alt. Relay K3

Closes when K5 opens during STBY power conditions.

8 Standby Normal Relay (K5)

The (K5) energizes to let the DC standby bus receive power from DC bus 1.

9 Sw. Hot Bat. Bus Relay K8

Closes with Batt. Switch in ON Position.

10 R9 Dc Bus Tie Relay

Opens during Autoland or by switching transfer switch to the off position.

11 TR3 Transfer Relay

The Relay Energizes To Let Tru 3 Receive Power From Ac Transfer Bus 1 When Ac Transfer Bus 2 Loses Power When Bus Transfer Switch Is In The Auto Position.

12 Ground Service Xfer Relay 1/2

Controlled By The Ground Service Switch At Fwd Att. Panel Through The BPCU.

13 Aux Bat. RCCB

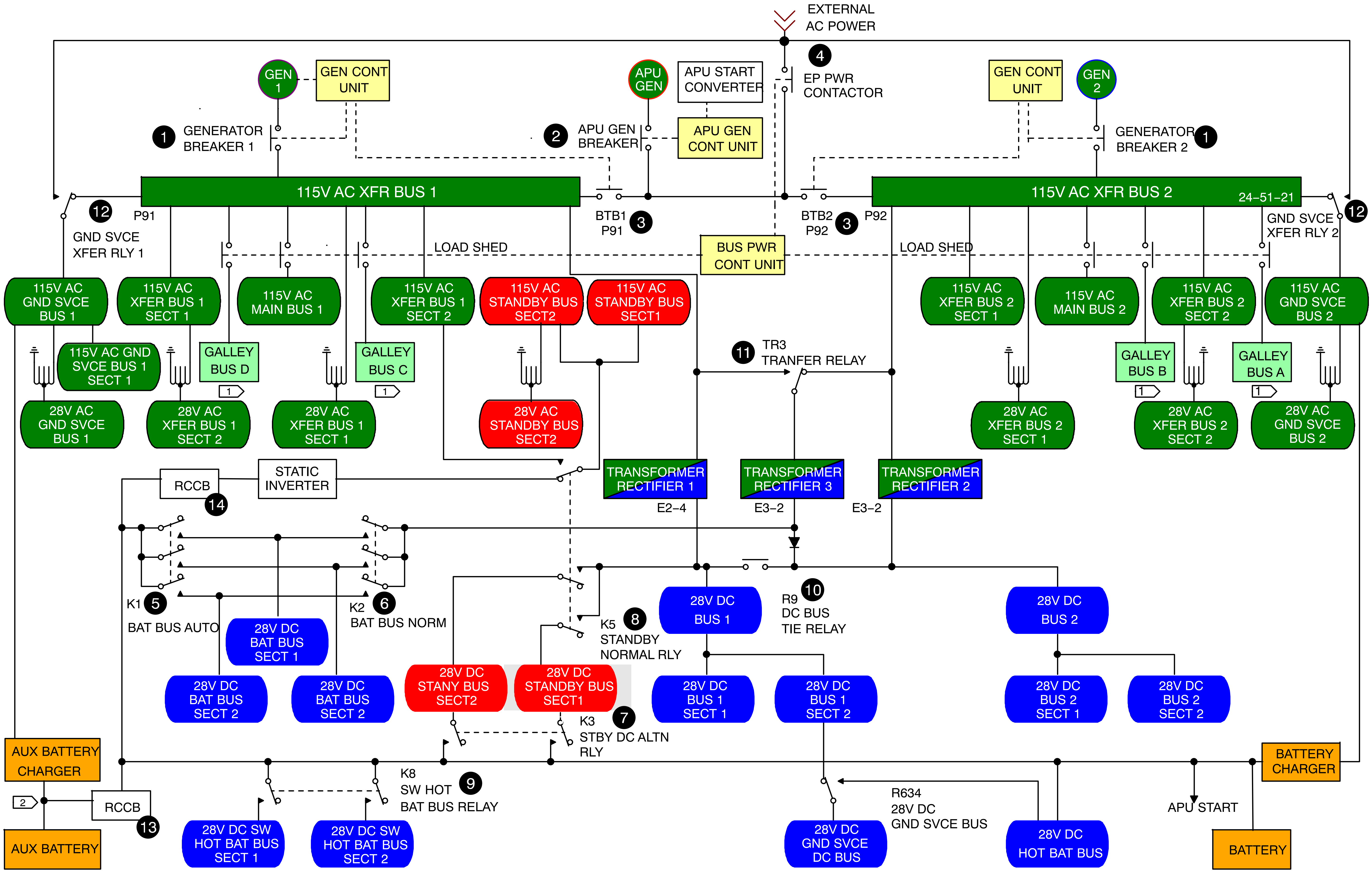
Closes Only When Batt. Stby. Power Is Active.

14 Satic Inverter RCCB

This Rccb Is Normally Closed By The Spcu.
These Relays Are Inside And Controlled By The Spcu:

These Relays are inside and controlled by the SPCU:

- Battery Bus Normal Relay (K2)
- Battery Bus Alternate Relay (K1)
- Standby Normal Relay (K5)
- Standby Dc Alternate Relay (K3)
- Switched Hot Battery Bus Relay (K8).



NOTES:

1 DRAWING SHOWS MAXIMUM GALLEY CONFIGURATION

2 DUAL BATTERY CONFIGURATION ALLOWS 60 MINUTES STANDBY OPERATION

Figure 24 Electrical Power Schematic

Reference to Figure 25 Engine & APU Fire Detection System Schematic

ATA 26 FIRE PROTECTION

26-10/15 ENGINE & APU FIRE DETECTION

GENERAL

The fire protection systems monitor the airplane for these conditions:

- Fire
- Smoke
- Overheat
- Pneumatic duct leaks.

Fire/Overheat Detection

The airplane has these fire/overheat detection systems:

- Lavatory smoke detection
- Engine fire/overheat detection
- APU fire detection
- Wheel well fire detection
- Wing/Body overheat detection.
- Cargo compartment smoke detection

Extinguishing

The airplane has these fire extinguishing systems:

- Lavatory fire extinguishing bottles
- Engine fire extinguishing bottles
- APU fire extinguishing bottle
- Portable fire extinguishers.
- Cargo compartment fire extinguishing bottle.

1 Fire Control Panel

The overheat/fire control panel monitors the fire protection system for these conditions:

- Engine overheat
- Engine fire
- APU fire
- Wheel well fire
- L bottle discharge
- R bottle discharge
- APU bottle discharge
- Engine fire protection fault conditions
- APU fire protection fault conditions.

The overheat/fire control panel lets you do these functions:

- Set the mode of operation (single or dual loop opera t i on)
- Operation of the fire extinguisher bottles
- Do a test of the fire extinguisher bottle squibs
- Do a test of the fire protection system
- Do a test of the fault detection circuits
- Stop the fire alarm bell.

2 Engine And APU Fire Detection Module

The engine and APU fire detection control module monitors detector elements for overheat and fire conditions in the engine and APU areas. Under normal conditions, all front panel lights are off.
When a fault condition occurs, the related FAULT AREA comes on. The FAULT DISPLAY lights show a fault code.
When you push the FAULT/INOP test switch, faults are simulated to do a check of the circuit ability to detect a fault.
If the circuits operate correctly, all lights on the front panel come on.
If a light does not come on, it shows a faulty circuit operation.
The FAULT DISPLAY lights show the type of fault and the detector location.

3 Fire Detection Loops

The engine fire detection system uses dual overheat/fire detector loops.
The loops are identified as loop A and loop B.
The detector loops on the engine supply overheat and fire signals to the engine and APU fire detection control module.
This module uses the signals to set the related alarm indications in the flight compartment. There are two fire detection loops on each engine.
One is loop A and the other is loop B.
Each loop has four detectors.
The detector elements have these components:

- Overheat pressure switch
- Fire pressure switch
- Fault pressure switch
- Resistors
- Terminal Stud
- A stainless steel, gas filled tube.

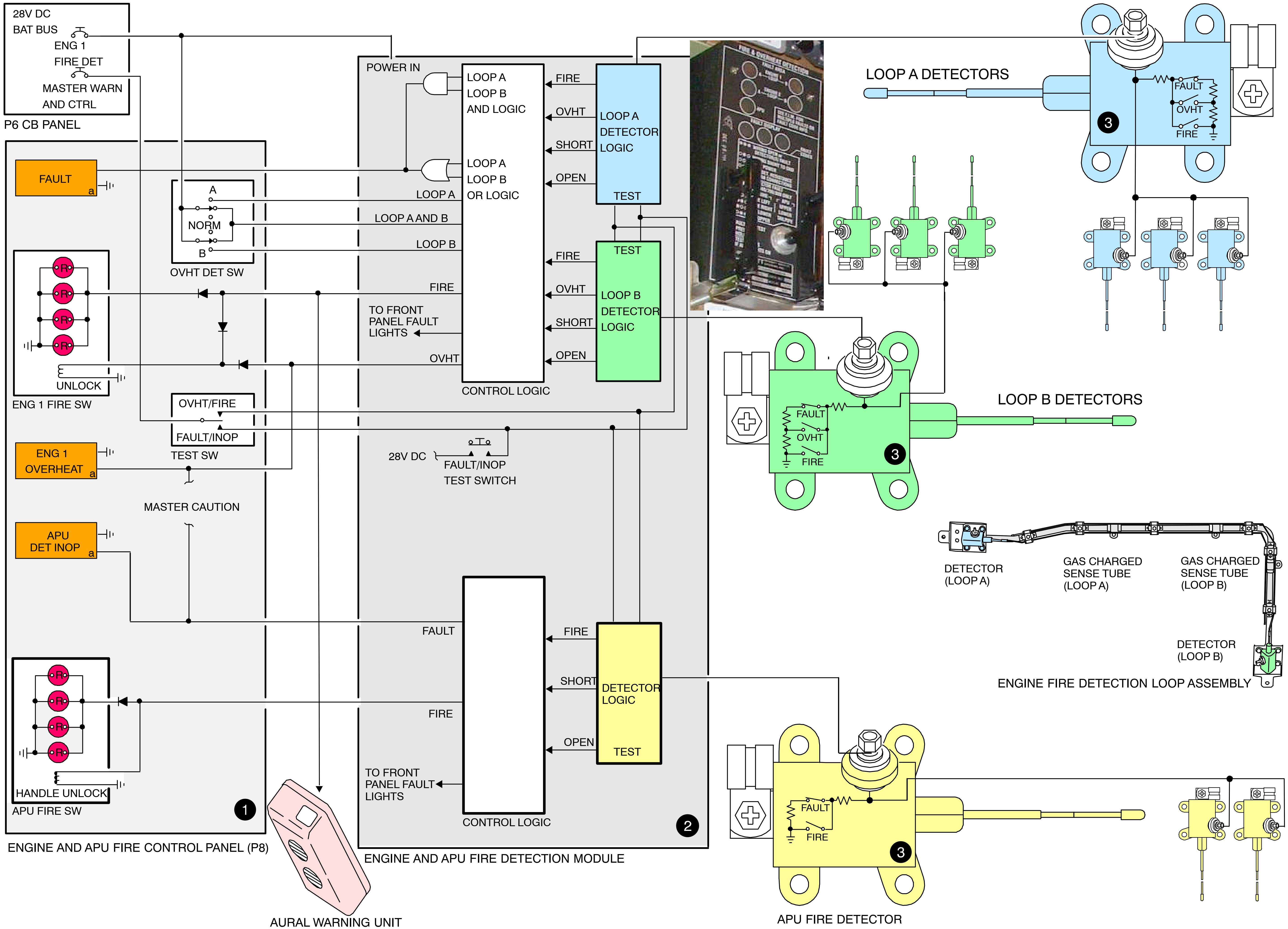


Figure 25 Engine & APU Fire Detection System Schematic

Reference to Figure 26 Wheel Well/Wing Body & Duct Overheat Detection System

26-17 WHEEL WELL OVERHEAT DETECTION

GENERAL

The wheel well fire detection system uses overheat sensing elements in the main wheel well. It monitors the wheel well for fire condition. When the system senses a fire condition, alarm indications operate in the flight compartment. The indications are on the glareshield panel P7 and on the engine and APU fire control panel P8. A bell also operates in the flight compartment.

1 Wheel well fire detector elements

Fire (overheat) sensing element in the main wheel well supplies the wheel well fire detection signal.

2 Compartment overheat detection controller

The compartment overheat detection controller supplies power to the detector elements. The microprocessor monitors the wheel well detector elements for alarm conditions. If the microprocessor senses a wheel well fire, it keeps the alarm in memory and sets the fire condition.
If the wheel well fire alarm comes on due to a real fire or a fault, the MAINT ADV light on the compartment overheat detection controller comes on. Use the module to do a check for real alarm or a fault condition.

For ATA 26-18:

The microprocessor monitors the wing/body detector elements for overheat conditions also. If the microprocessor senses a wing/body overheat condition it holds the alarm in memory and sets the alarm condition. MAINT ADV light comes on.

3 Engine and APU fire control panel

Red WHEEL WELL light on engine and APU fire control panel comes on during Fire or Test Condition. Additional Fire Warn Lights on P7 and Fire Bell from the Aural Warning Module appears. You use the test switch on engine and APU fire control module panel to the OVHT/FIRE position to do a test of the wheel well sensing element.

26-18 WING & BODY OVERHEAT DETECTION

GENERAL

The wing and body overheat detection components monitor for overheat conditions. If they sense an overheat condition, a signal goes to the compartment overheat detection control module. This module sets the overheat alarm. These are the flight compartment indications for a wing and body overheat condition. The P5 wing-body overheat light comes on, P7 master caution light comes on, P7 AIR COND annunciator light comes on. If there is an overheat condition, the MAINT ADV light on the compartment overheat detection controller comes on.

4 P5 Control Panel

Wing/Body overheat light comes on in case of an overheat condition. P7 master caution and AIR COND lights comes on.

5 Sensing Elements

If the sensing element has continuity, the indications are the same during test and during a real alarm. If the sensing element does not have continuity, there are no indications in the flight compartment. There is no difference between the real alarm and a short circuit.

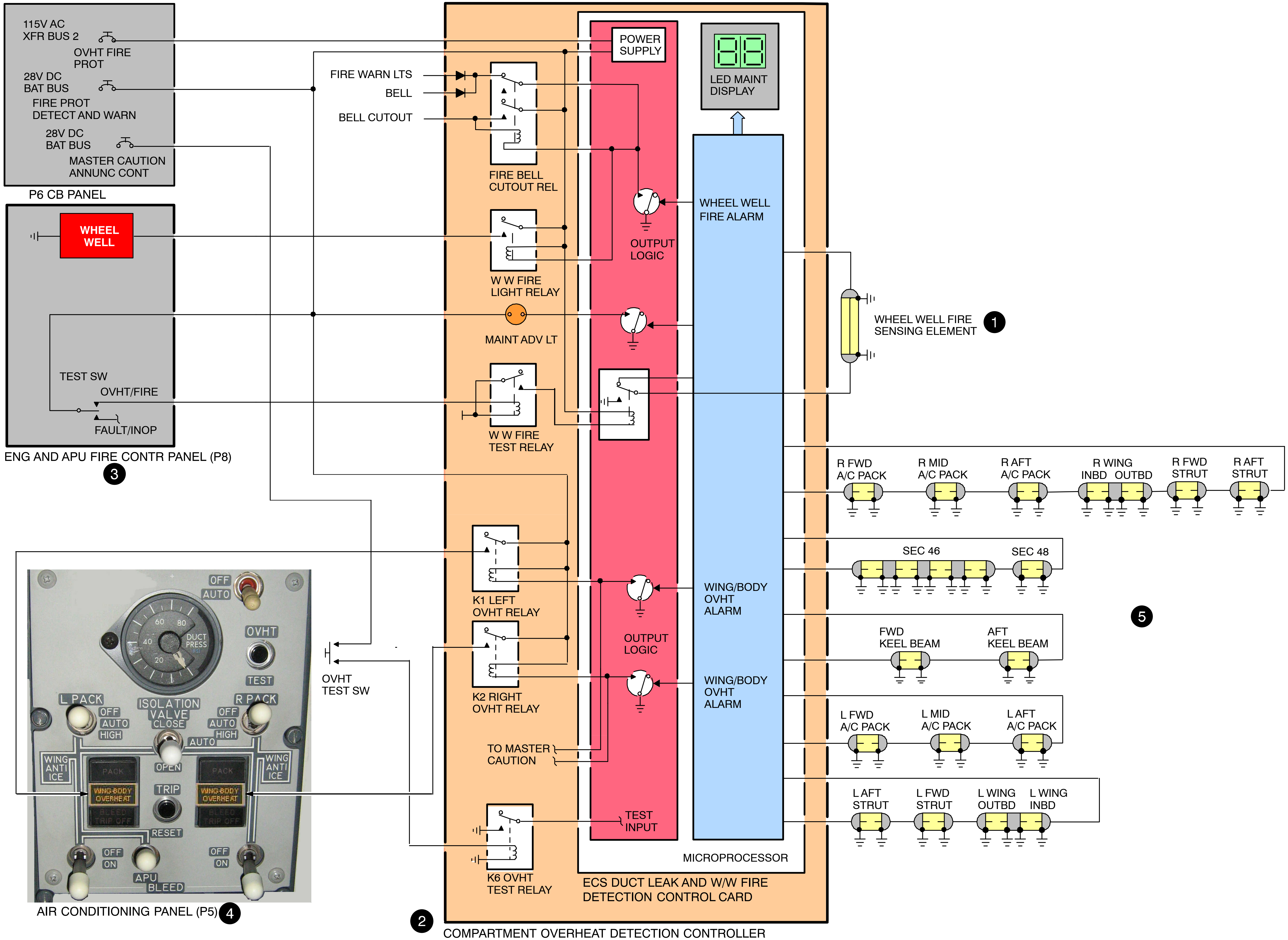


Figure 26 Wheel Well/Wing Body & Duct Overheat Detection System

General

The Engine and APU fire extinguishing system extinguishes fires in the Engine and APU compartment. When you operate the Engines/APU fire extinguishing system, it fills the Engine/APU compartment with halon gas to extinguish the fire. The Engine/APU fire extinguishing system has these components:

- Fire extinguisher bottles
- Overheat/Fire protection panel
- APU ground control panel.

1 The Overheat/Fire Control Panel

The overheat/fire control panel is on the P8 panel. These are the displays on the overheat/fire control panel:

- WHEEL WELL fire warning light
- ENG OVERHEAT light
- Fire warning switch lights
- Bottle discharge lights
- FAULT light
- APU DET INOP light
- EXT TEST lights

These are the controls on the overheat/fire control panel:

- Fire warning switches
- TEST switch
- OVHT DET switches
- EXT TEST switch

When there is a fire condition, the Engine /APU fire warning switch unlocks. You can also use the warning switch override under the handle to unlock the switch. When you pull the Engine/APU fire warning switch up, the Engine/APU systems are shutdown and isolated. Turn the Engine/APU fire warning switch clockwise or counter-clockwise. This causes the Engine/APU fire extinguisher bottle to discharge halon gas.

2 APU GROUND CONTROL PANEL

On the ground,the APU ground control panel gives you visual and aural indications of an APU fire. The control panel also lets you extinguish an APU fire. The APU ground control panel has these components:

- Red fire warning light
- Fire horn
- Horn cutout switch
- APU fire control handle
- Bottle discharge switch.

When there is a fire in the APU, the horn and light operate alternately and the APU stops.
When you push the horn cutout button the horn sound stops and the red light stays on continuously.

When you pull the APU fire control handle, the APU system stops and isolates from other systems.
When you pull down the APU fire control handle, you also arm the bottle discharge toggle switch.
You push the toggle switch to cause the APU bottle

3 EXTINGUISHER BOTTLES

The engine fire extinguisher bottles contain the halon gas that extinguishes an engine fire, each engine fire extinguisher bottle contains a :

- Pressure gage and switch
- Safety relief port
- Two electrical connections
- Two discharge ports with squibs.

The two engine fire extinguisher bottles are in the upper aft left corner of the left main wheel well.
The APU fire extinguisher bottle is in the section 48 horizontal stabilizer accessory compartment.

4 EXTINGUISHER BOTTLE SQUIB

The purpose of the squib is to break the diaphragm seal and start the release of the halon gas from the bottle. The squib is an explosive device that operates electrically.

5 Power Supply

The Power Supply for Fire Extinguishing is always 28VDC from the Hot Battery Bus.

6 Pressure Indication

The Pressure Gage allows to check the Bottle for correct pressure without removing the Fire Ex Bottles.

7 Pressure Switch

The Pressure Switch Triggers the Bottle Discharge Lights at the P8 OVHT/Fire Control Panel to on.

8 Check Valve

The Check Valves prevent the bottle pressure from one bottle to enter the other bottle.

9 Engine and APU Fire Ext Test

The engine and APU fire extinguisher test does a check for fire extinguisher bottle squib continuity.
The green test lights and bottle discharge lights come on to show a successful test.

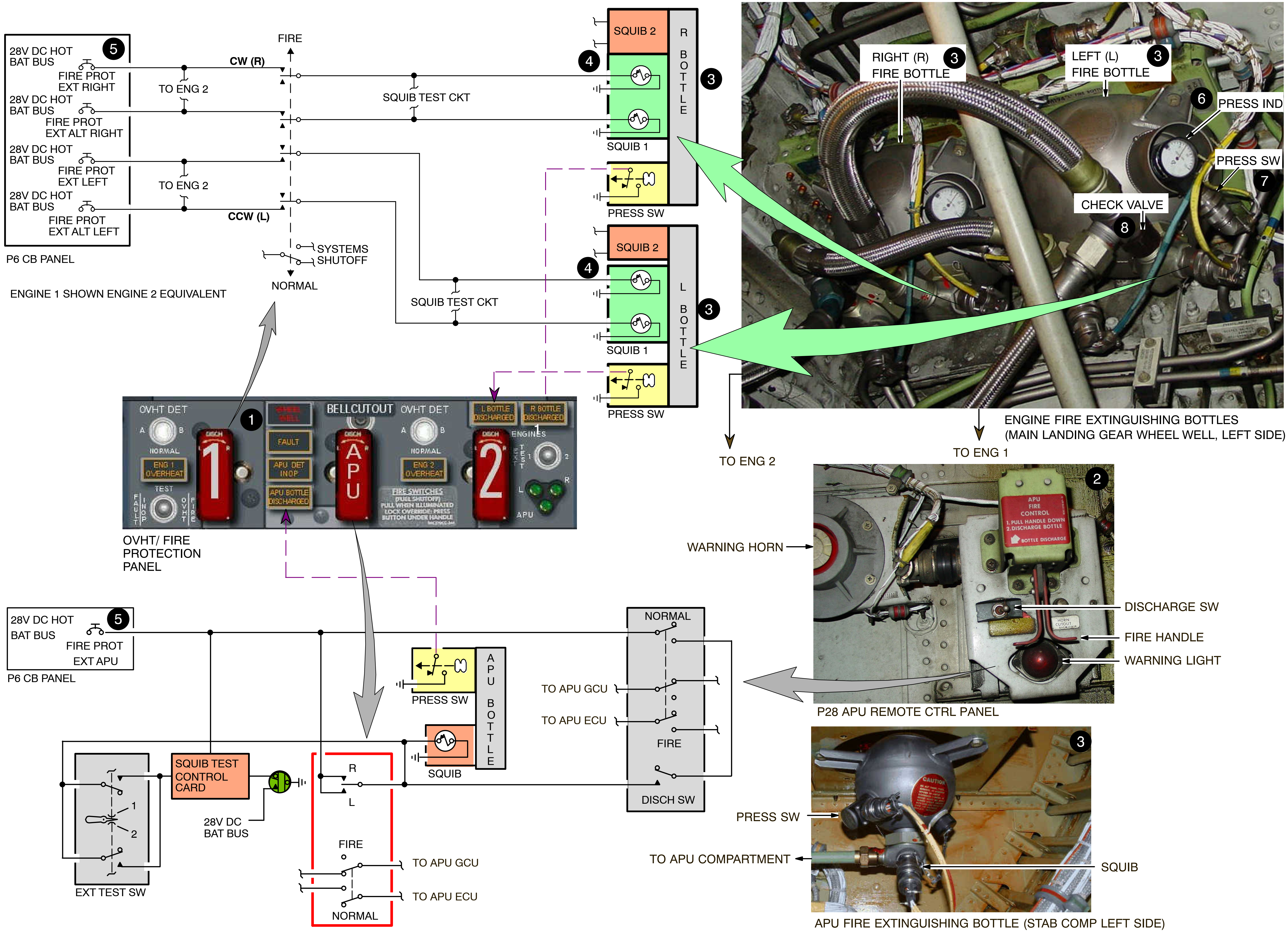


Figure 27 Engine & APU Fire Extinguishing System Schematic

General

The lower cargo compartment smoke detection system gives warnings in the flight deck, if there is smoke in a lower cargo compartment. The warnings are for the forward and aft lower cargo compartments.

1 Cargo Smoke Detection and Fire Suppression Module

These are the components on the cargo smoke detection and fire suppression module:

- DETECTOR FAULT amber light is on if one or more of the detectors has a power failure.
- A three−position (A, NORM, B) DET SELECT SWITCH, one for each cargo compartment.
- NORM position lets both detectors or with one detector failed sense smoke and give fire alarm.
- A or B lets the selected detector sense smoke and give fire alarm.
- TEST push button switch, does a test of cargo smoke detectors and extinguishing system.
- FWD, AFT red cargo fire warning switchlight is on if smoke is detected in the related cargo compartment.
- Smoke detection in the forward or aft cargo compartment puts on the two fire lights on the P7 panel and operates the fire bell in the aural warning unit.

2 Cargo Electronic Unit

The cargo electronic units monitors the forward and aft lower compartment smoke detectors. They are identical. The cargo electronic units have these components:

- 16 red light emitting diodes (LEDs)
- Lamp test switch
- System test switch
- Electronic circuits

The CEUs are in the ceiling of the forward and the aft lower cargo compartment.

3 Cargo Smoke Detectors

The smoke detectors monitor air in the lower forward and aft cargo compartments for smoke. The forward and aft lower cargo smoke detectors are identical. The smoke detectors have these components:

- Smoke detection chamber (internal)
- Electronic circuit.

The smoke detectors use photoelectric cells to detect smoke. The smoke detectors are in pans in the ceiling of the forward lower cargo compartment and in the aft lower cargo compartment.

4 Fire Extinguisher Bottle

The bottle contains halon fire extinguishing agent pressurized with nitrogen. The fire extinguishing bottles have these components:

- Safety relief and fill port
- Pressure switch with test button
- Two discharge assemblies with squibs.

5 Power Source

For Cargo Smoke detection the 28 VDC Battery Bus is the Power Source. For Cargo Fire Extinguishing the 28 VDC Hot Battery Bus is the Power Source.

6 Aural Warning Unit

The Aural Warning Unit sounds the Fire Bell when an Cargo Smoke Condition is detected.

7 Master Caution Annunciator

The Fire Warning, Master Caution and Master Caution annunciator Lights (OVHT/DET) are illuminated when a Smoke Condition is detected.

8 Test CEU/Flight Compartment

Smoke Detection Test (CEU)
These are the results of the test:

- LAMP TEST, if any of the 16 red lights do not come on, change the CEU
- PRESS TO TEST, all 16 red lights come on, test passed.

If during test, the red light does not come on, change smoke detector or check jumper cable.

At the same time, these show on P8−75:

- 2 EXT FWD, AFT green lights come on
- FWD and AFT red switchlights come on
- DISCH amber light comes on.
- DETECTOR FAULT amber light is on.

Smoke Detection Test (Flight Compartment)
These are the results of the test:

- TEST, 2 EXT FWD, AFT green lights come on
- FWD and AFT red switchlights come on
- DISCH amber light comes on
- FIRE red lights come on and bell rings

At the same time on the CEU, 16 red lights come on. If the FWD or AFT red switchlight does not come on, select A or B on DET SELECT switch and do the test again. A red light on the CEU not on shows you which detector is failed or a problem with the external jumper loop.

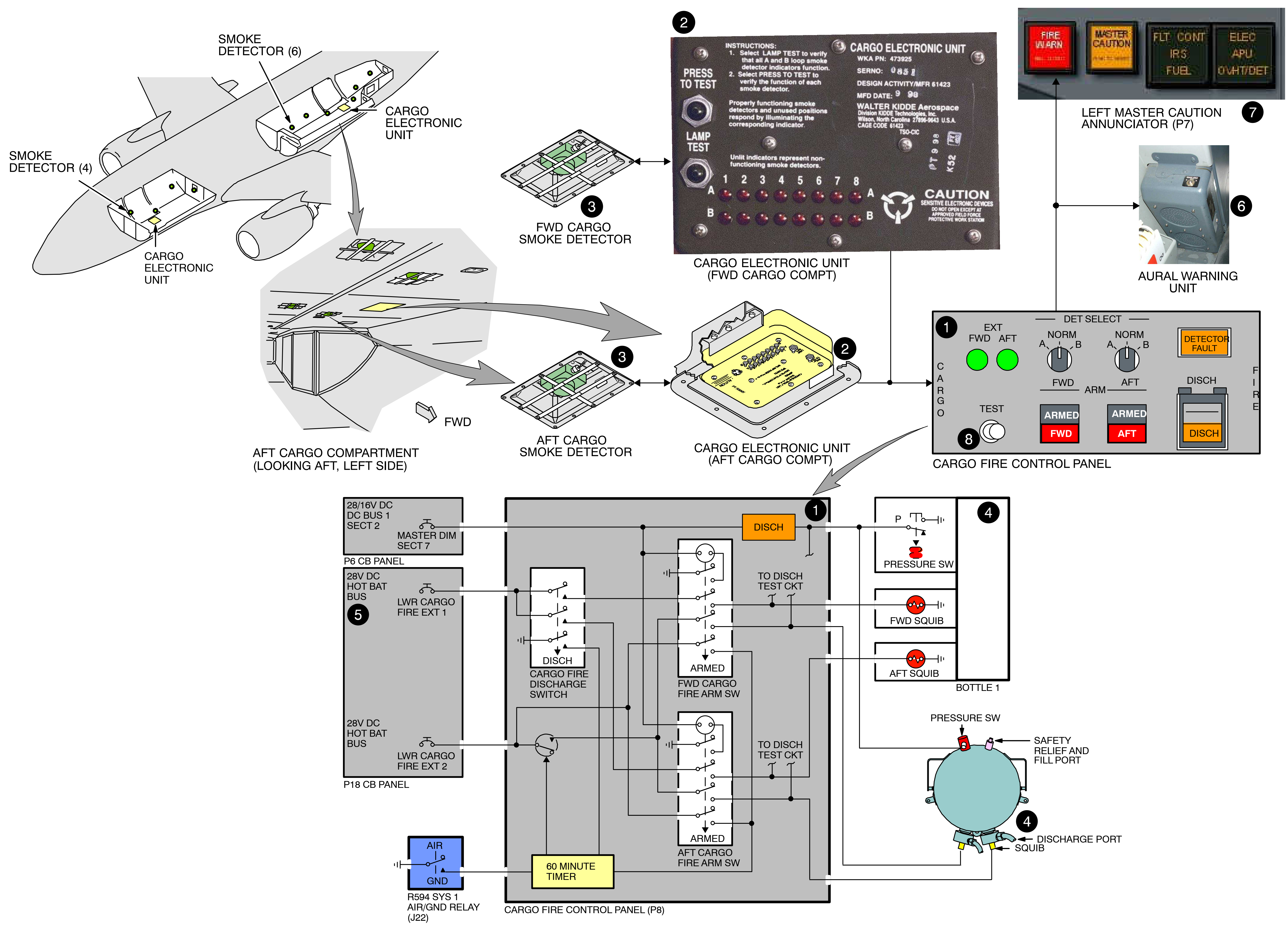


Figure 28 Cargo Smoke Detection System Schematic

Reference to Figure 29 Aileron System Basic Schematic

ATA 27 FLIGHT CONTROLS

27-11 AILERON SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The aileron and aileron trim control system provides airplane lateral control about the longitudinal axis. The aileron system consists of one aileron with balance tab on each wing. The ailerons are positioned by cables that are driven by two hydraulic power control units located on the forward wall of the main wheel well. Control inputs to these power control units are through a cable system actuated by rotation of either control wheel, an electric aileron trim system or the autopilot.The two control wheels are interconnected by cables attached to the base of each control column in the lower nose compartment. The left and right aileron cables are driven by control drums at the base of each column.The left and right aileron cables run aft through the outboard section of the floor beam to quadrant assemblies above the main wheel well. Quadrant assembly torque tubes project into the wheel well. The aileron control quadrant assembly, centering spring and trim mechanism, electric trim actuator, aileron power units and aileron control bus drums are located on the left forward wall of the main wheel well.

1 Aileron Control Wheel

The flight crew uses two control wheels for roll control operation.

2 Aileron Transfer Mechanism

The aileron transfer mechanism supplies a load path for roll control. In normal operation, the mechanism lets either pilot make the roll control commands. If the control wheel cannot move, the transfer mechanism lets the pilot operate the other control wheel. If the cable or a connection breaks, you can use the other control wheel.

3 Aileron Control Wheel Drum

The aileron control wheel drum assembly connects the two control wheels and the left body cables.

4 Aileron Power Control Unit

The aileron power control units supply the hydraulic power to move the ailerons. The upper PCU gets system B pressure and the lower PCU gets system A pressure.

5 Aileron Autopilot Actuator

The output cranks of the autopilot actuators are linked together and connected to the upper PCU crank on the aileron quadrant assembly shaft. Output from either autopilot actuator drives the quadrant assembly resulting in an input to both PCUs. The left autopilot actuator is powered by hydraulic system B, the right by hydraulic system A. The control inputs come from the respective Flight Control Computer.

6 Aileron Feel And Centering Unit

The aileron feel and centering unit receives the aileron inputs and controls the aileron PCUs. The unit gives a feel force to the pilot. It also moves the control wheel to a neutral position when there is no input. The aileron trim actuator changes the neutral position of the ailerons and the control wheels.

7 Aileron Body Quadrants

The aileron body quadrants move the wing cables to control the aileron position. Each aileron body quadrant connects to one crankshaft. The PCU housing connects through a crank to the related crankshaft. The cables from the upper quadrant connect to the right wing quadrant. The cables from the lower quadrant connect to the left wing quadrant.

8 Aileron Spring Cartridge

The aileron spring cartridge is a spring loaded rod. It connects the upper aileron PCU output with the spoiler quadrant assembly shaft.

9 Aileron And Wing Quadrant

Each wing cable connects the body quadrant with the aileron wing quadrant. A cable tension spring is at the end of the cable run. The aileron front spar connects to the wing structure by hinges. Aileron movement is controlled by a pushrod between the aileron and the cable quadrant. The forward side of the aileron connects to the balance panels. The balance tab connects to the aileron rear spar by hinge fittings. The aileron balance panels and tab decrease the force necessary to move the aileron in flight during manual reversion.

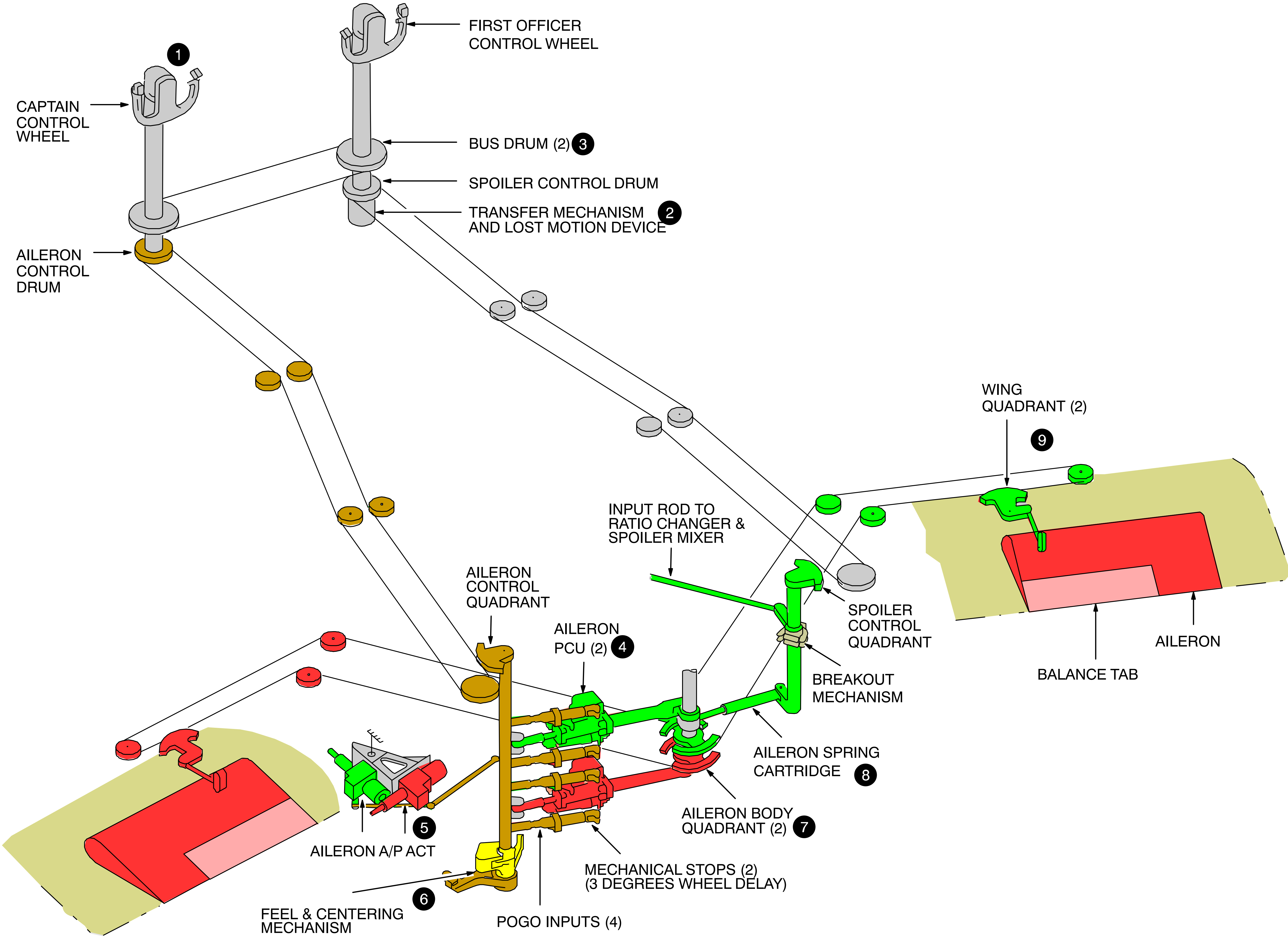


Figure 29 Aileron System Basic Schematic

Reference to Figure 30 Flight Spoiler Control System Basic Schematic

27-61 FLIGHT SPOILER CONTROL SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The flight spoilers help the ailerons to control the airplane roll. They also supply speedbrake control to reduce lift and increase drag druring landing and rejected takeoff. The control wheels and speedbrake lever are used to manually move the flight spoilers.

The control wheel gives mechanical input through the feel and centering unit to the aileron PCUs (**P**ower **C**ontrol **U**nits). The aileron PCUs supply mechanical inputs through the spoiler mixer and ratio changer to the flight spoiler actuators. Hydraulic pressure from the spoiler shutoff valves on the flight control modular packages goes to the actuators. After a specified amount of control wheel movement, a control valve in each flight spoiler actuator permits hydraulic power to move the actuators. Each actuator moves a flight spoiler.

The speedbrake lever supplies mechanical inputs through the spoiler mixer and ratio changer to the flight spoiler actuators. The spoiler mixer mixes the control wheel input with the speedbrake lever input. The actuators move the flight spoilers on each wing symmetrically.

1 Control Wheel

The control wheel gives mechanical input to the aileron PCUs to control the airplane roll.

2 Speedbrake Lever

The speedbrake lever sends mechanical inputs to the spoiler ratio changer. The ratio changer sends the inputs to the spoiler mixer.

3 Auto Speedbrake Actuator

The auto speedbrake actuator moves the speedbrake lever during landings and RTOs (**R**ejected **T**ake**o**ffs).

4 Spoiler Control Quadrant

The spoiler control quadrant receives inputs from the control wheels and the aileron PCUs. The quadrant sends these inputs to the spoiler ratio changer.

5 Spoiler Ratio Changer

The spoiler ratio changer receives inputs from the spoiler control quadrant and the speedbrake lever. The ratio changer sends the commands to the spoiler mixer. The commands then go from the spoiler mixer through the ratio changer to the flight spoiler actuator quadrants.

6 Spoiler Mixer

The spoiler mixer combines the inputs from the spoiler control quadrant and the speedbrake lever. The spoiler mixer then sends the flight spoiler commands back to the ratio changer and sends the ground spoiler commands to the ground spoiler control valve. The ground spoiler control valve permits the ground spoilers to operate.

7 Flight Spoiler Actuator Quadrants

The flight spoiler actuator quadrants send the commands to the flight spoiler actuators.

8 Flight Spoiler Actuators

The flight spoiler actuators use hydraulic power to move the flight spoilers.

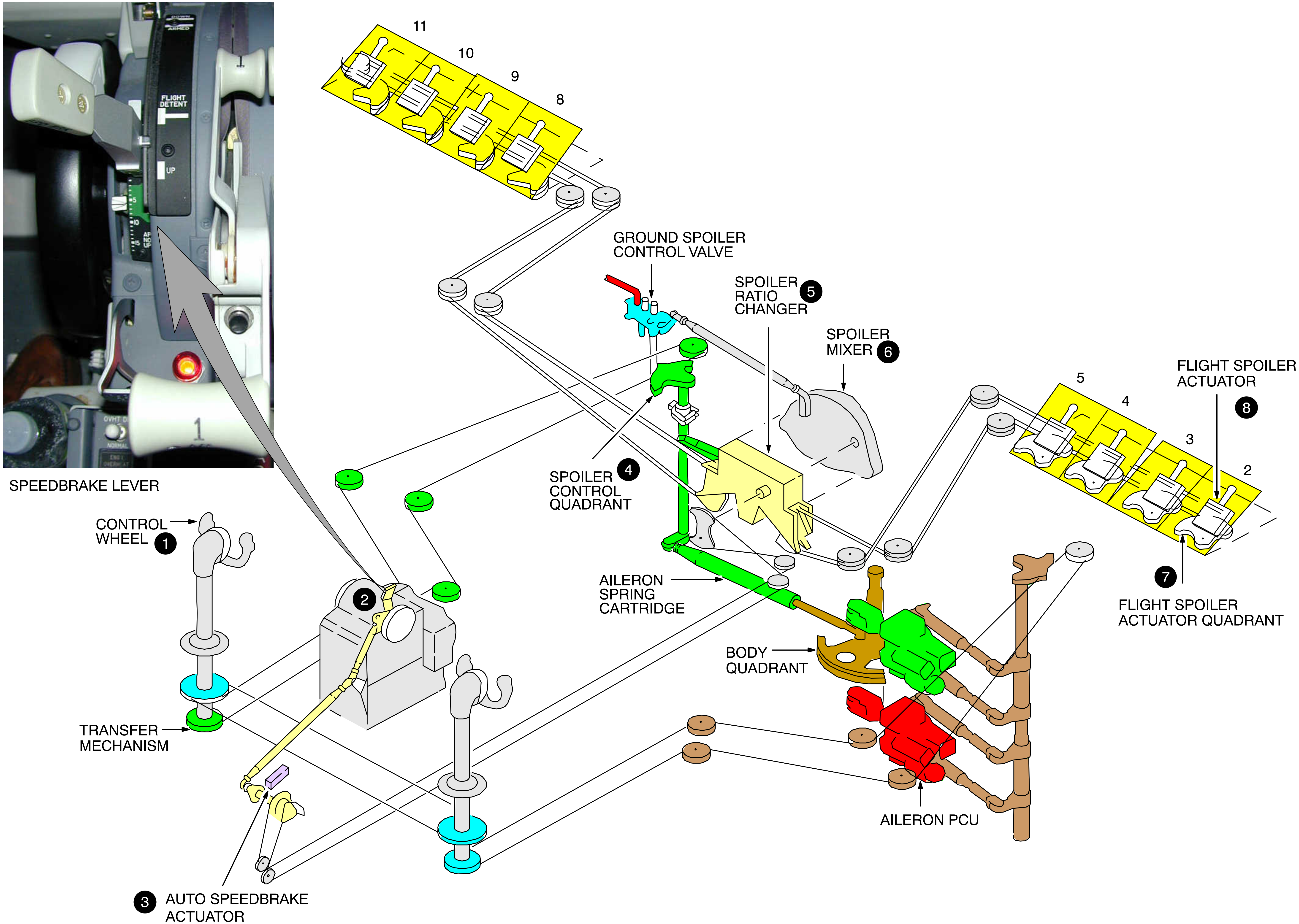


Figure 30 Flight Spoiler Control System Basic Schematic

Reference to Figure 31 Ground Spoiler Control System Basic Schematic

27-61 GROUND SPOILER CONTROL SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The speedbrake lever supplies mechanical inputs through ratio changer and the spoiler mixer to control the flight spoilers and the ground spoilers. The spoiler mixer controls the ground spoiler control valve when the speedbrake lever moves 31° The ground spoiler actuators move the ground spoilers to full up on each wing symmetrically when the airplane is on ground.

1 Speedbrake Lever

The speedbrake lever sends mechanical inputs to the spoiler ratio changer. The ratio changer sends the inputs to the spoiler mixer. When the speedbrake lever moves 31°, the spoiler mixer moves the ground spoiler control valve.

2 Auto Speedbrake Actuator

The auto speedbrake actuator moves the speedbrake lever during landings and RTOs (**R**efused **T**ake**o**ffs).

3 Spoiler Ratio Changer

The spoiler ratio changer receives inputs from the spoiler control quadrant and the speedbrake lever. The ratio changer sends the commands to the spoiler mixer.

4 Spoiler Mixer

The spoiler mixer combines the inputs from the spoiler control quadrant and the speedbrake lever. The spoiler mixer then sends the flight spoiler commands back to the ratio changer and sends the ground spoiler commands to the ground spoiler control valve. The ground spoiler control valve permits the ground spoilers to operate.

5 Ground Spoiler Control Valve

The ground spoiler control valve sends hydraulic power to the ground spoiler interlock valve when the speedbrake lever moves 31 degrees.

6 Ground Spoiler Interlock Valve

The ground spoiler interlock valve is a mechanically operated hydraulic valve that is spring loaded to the air mode position.

A push/pull cable attaches to the ground spoiler interlock valve and to the right main landing gear upper torsion link. When the right main landing gear compresses during landing, the cable controls the input crank of the interlock valve. The interlock valve then moves to the ground mode position and sends hydraulic system A power from the ground spoiler control valve to the ground spoiler actuators.

7 Ground Spoiler Actuators

The ground spoiler actuators use hydraulic system A pressure to move the ground spoilers. Each ground spoiler actuator has an internal mechanical lock which locks the actuator in the retract position when there is no extend pressure. The ground spoilers No. 1 and No. 12 have one actuator. The ground spoilers No. 6 and No. 7 have two actuators.

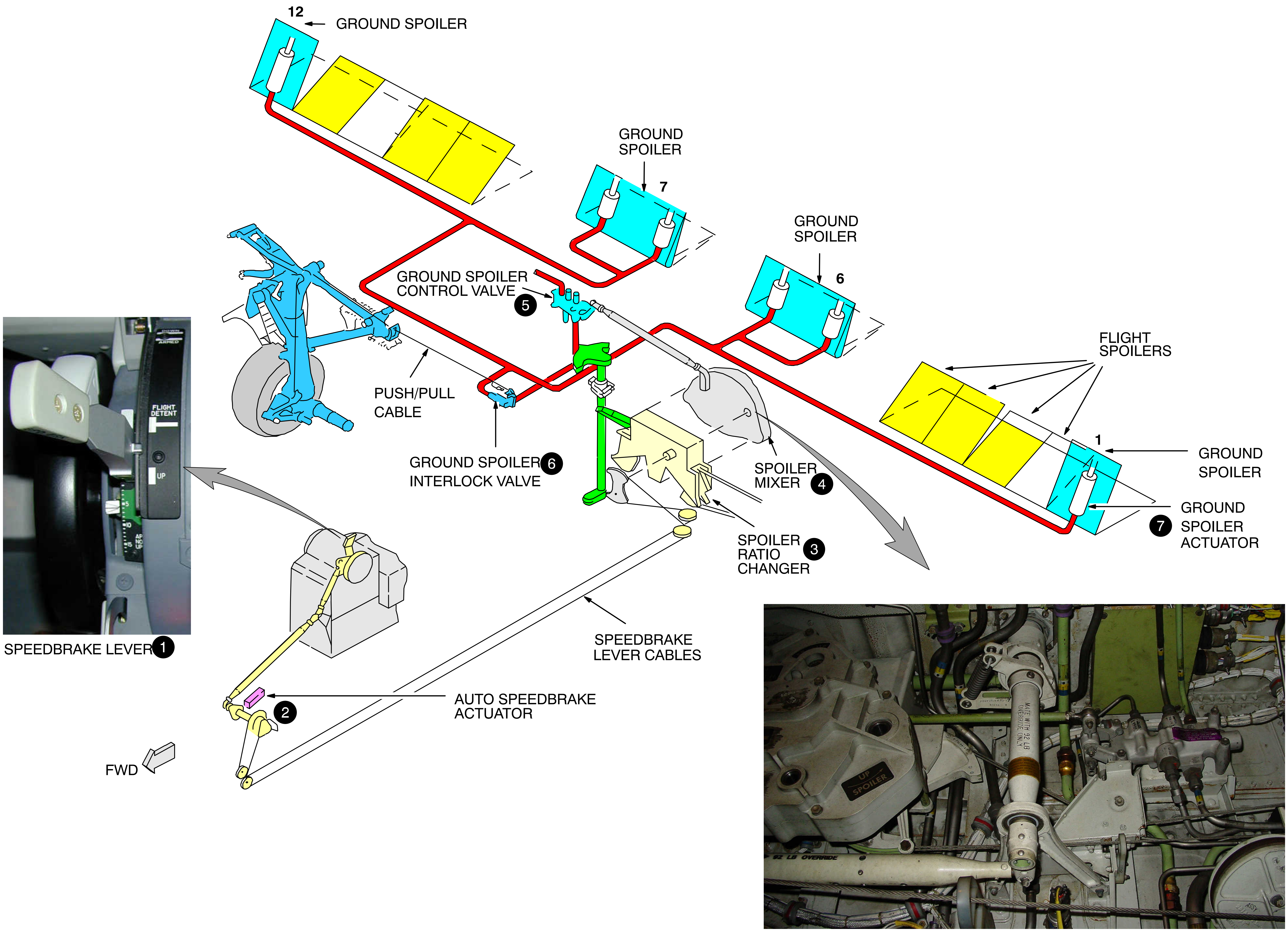


Figure 31 Ground Spoiler Control System Basic Schematic

Reference to Figure 32 Elevator Control System Basic Schematic

27-31 ELEVATOR AND TAB CONTROL SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The elevators control the pitch attitude of the airplane about the lateral axis. The pilots manually control the position of the elevators with forward and aft movement of the control column.When the autopilot engages, it automatically controls the position of the elevators. During autopilot operation, the actuators backdrive the control columns. The control column gives mechanical input to the elevator PCU (**P**ower **C**ontrol **U**nit) through cables and linkages. The elevator PCU uses hydraulic pressure to mechanically move the elevator through the output torque tube.

1 Control Columns

The control columns extend through the flight compartment floor and attach to the elevator forward control quadrants. They move the forward input torque tube. This moves the elevator forward control quadrants and the cables to control the elevator position. When the forward input torque tube moves, it gives a mechanical input to the column cutout switch modules.

2 Elevator Input Torque Tube

The elevator input torque tube transmits elevator inputs to the elevator PCUs. The elevator input torque tube receives these inputs:

- Pilot inputs through the elevator aft control quadrants
- Autopilot inputs through the elevator autopilot actuator input crank
- Stabilizer position through the elevator feel and centering unit
- Mach trim actuator position through the elevator feel and centering unit.

When the elevator aft control quadrants move, they move the elevator input torque tube. This moves the elevator PCU input pogos.

3 Elevator Feel and Centering Unit

Feel force is provided by the feel and centering unit and the dual feel actuator. Inputs to the feel and centering unit are provided by the stabilizer, the flight control computers, and elevator feel computer. The stabilizer inputs go through the elevator neutral shift rods. The flight control computer inputs go through the mach trim actuator. The elevator feel computer inputs go through the dual feel actuator. The dual feel actuator adds a variable feel force to the spring force in the feel and centering unit.

4 Elevator Power Control Units

The two elevator PCUs are on the empennage wall. The right PCU gets system B pressure and the left PCU gets system A pressure. An elevator input goes through the input pogos to the PCU input cranks. The primary and secondary input cranks move the slides in the control valve and supply pressure to the actuator. This causes the housing to move and changes the output torque tube position and the elevators move.

5 Elevator Autopilot Actuators

The output cranks of the autopilot actuators are linked together and connected to the elevator input torque tube. Output from either autopilot actuator drives the quadrant assembly resulting in an input to both PCUs.

6 Elevator Output Torque Tube

The elevator output torque tube connects with the two elevator PCUs. It also connects to both elevators through elevator control rods. It receives inputs from the two elevator PCUs. When one or both of the PCUs move, they move the torque tube and both elevators.

7 Elevators

The elevators are attached to the rear spar of the horizontal stabilizer. Each elevator has a tab and four balance panels. When the output torque tube moves, it moves the elevator control rods. This moves the elevators.

8 Elevator Feel Computer

The elevator feel computer changes the control column forces as the airspeed changes and the horizontal stabilizer moves. Hydraulic pressure from the system A and B flight control modules goes to the pressure ports. With the inputs airspeed and horizontal stabilizer position, the elevator feel computer sends metered pressure output to the dual feel actuator. The feel differential pressure switch monitors both computer metered pressures. It closes when it measures a difference of 25 percent between system A and B metered pressure and the FEEL DIFF PRESS light on the P5 panel comes on.

9 Elevator Feel Shift Module

The EFSM (**E**levator **F**eel **S**hift **M**odule) supplies increased system A pressure to the dual feel actuator to increase control column feel forces during a stall.

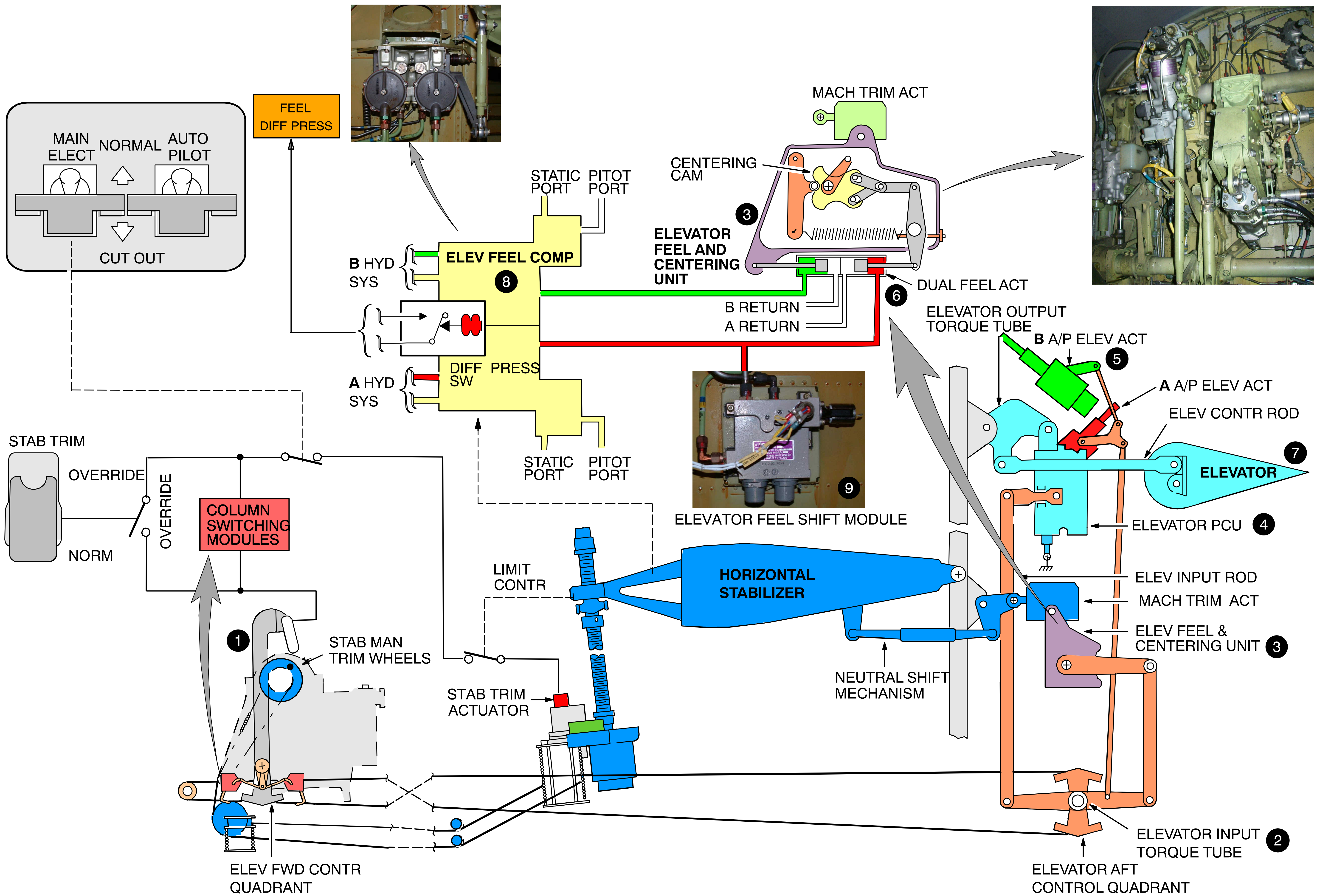


Figure 32 Elevator Control System Basic Schematic

Reference to Figure 33 Rudder and Rudder Trim System Basic Schematic

27-21 RUDDER AND RUDDER TRIM SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The rudder controls the flight attitude of the airplane about the vertical axis. The pilots manually command a yaw input with the rudder pedals. An input is also possible by the rudder trim control knob to control the rudder. When engaged, the yaw damper and WTRIS (**W**heel **T**o **R**udder **I**nterconnect **S**ystem) automatically control the rudder. During yaw damper operation, there is no feedback to the rudder pedals.

1 Main Rudder Power Control Unit

When the rudder pedals move, the rudder cables move. They move the aft control quadrant. It moves rudder torque tube and the PCU input rods. When each hydraulic system pressure is on, hydraulic pressure moves each bypass valve to the non bypass position. Pressure from system A and system B goes to the respective servo valve. The servo valves send pressure to the tandem actuator. This moves the PCU piston and the rudder. The external summing lever resets the control valve when the rudder moves to the selected position. When hydraulic system A or B pressure is removed, the associated bypass valve moves to the bypass position. This connects both sides of the piston, prevents a hydraulic lock, and lets the hydraulic system with pressure move the actuator.

2 Standby Rudder Power Control Unit

The standby rudder power control unit uses alternate hydraulic power to move the rudder. When standby hydraulic pressure is on, it opens the bypass valve and connects the actuator chambers to separate control ports. When the the rudder pedals move, the rudder input rod moves. This moves the external summing lever and the input crank. This positions the control valve to apply pressure to one chamber and open the other to return. The standby rudder PCU piston moves the rudder. As the PCU piston moves, the summing lever moves the input crank to null out the input. This stops the PCU movement at the correct position.

3 Load Limiter Valves

The load limiter function limits rudder authority when the airspeed is more than 137 knots. When the load limiter solenoid valves energize, it sends pressure to the lock pistons in the load limit relief valve. The lock pistons move and release the modulating valve. The modulating valve reduces the working pressure to both the A and B pistons to 2200 psi. The rudder output force is now 25% less which reduces rudder authority at blowdown.

4 Yaw Damper Solenoid Valve

When engaged, the yaw damper system gives input to the main PCU yaw damper solenoid valve. The solenoid valve moves and sends pressure from system B to the EHSV (**E**lectro**h**ydraulic **S**ervo **V**alve).

5 Yaw Damper Electrohydraulic Servo Valve

When the EHSV moves, it sends pressure to move the yaw damper actuator. The yaw damper actuator input mechanically adds to the pilot input on the internal summing levers.

6 Delta P Sensor

The Delta P Sensor of the FFM (**F**orce **F**ight **M**onitor) finds opposite pressure on the A and B sides of the tandem actuator. The FFM commands pressure to the standby PCU when finds opposite pressure on the A and B sides of the tandem actuator.

7 Rudder Feel and Centering Unit

The rudder feel and centering unit gives artificial feel to the rudder pedals, centers the input to the PCU, and transmits trim inputs to the aft control components.

8 Rudder Trim Actuator

The rudder trim control knob operates the electrical trim actuator. The trim actuator changes the neutral position of the rudder and the rudder pedals.

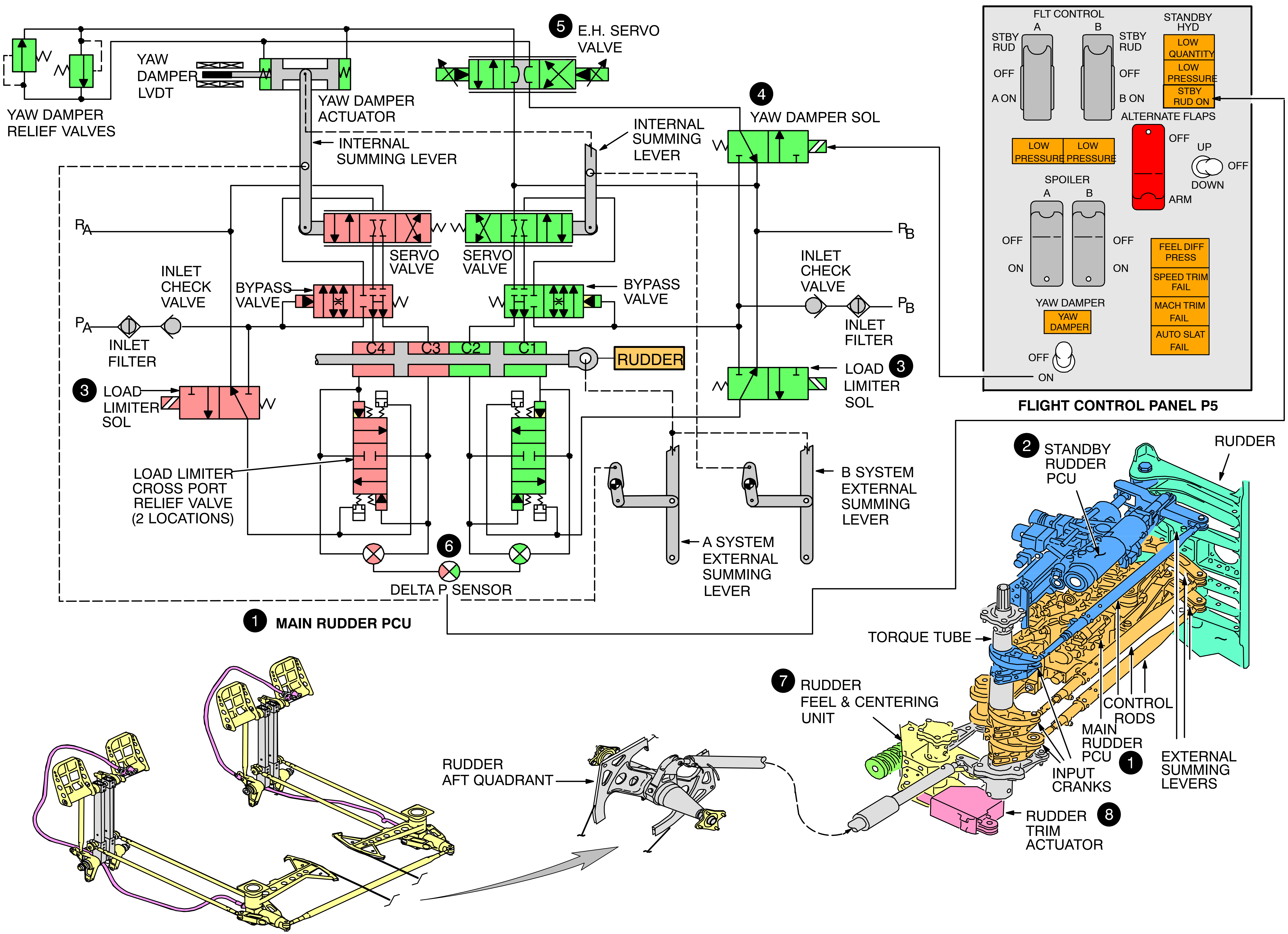


Figure 33 Rudder and Rudder Trim System Basic Schematic

Reference to Figure 34 Horizontal Stabilizer Trim Control System Basic Schematic

27-41 HORIZONTAL STABILIZER TRIM CONTROL SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The horizontal stabilizer controls the pitch trim of the airplane about the lateral axis. Main electric control of the horizontal stabilizer position is by the stabilizer trim switches. When the autopilot engages, it controls the position of the horizontal stabilizer. During autopilot or main electric operation, the actuator backdrives the stabilizer trim wheels in the cockpit. Also, the stabilizer trim wheels on each side of the control stand can be used to trim the horizontal stabilizer manually. This is the priority for control of the stabilizer:

- Manual Trim - Trim wheels on the control stand
- Main Electric Trim - Switches on the control wheels
- Autopilot Trim - Pitch channel or speed trim system

1 Stabilizer Manual Trim Wheels

When the trim wheels are turned by the handles, this moves the sprocket and chain and drives the forward cable drum. This moves the cables that go to the aft cable drum. The aft cable drum moves and drives the gearbox and jackscrew and the stabilizer.

2 Forward Cable Drum and Forward Control Mechanism

During electrical operation of the stabilizer the jackscrew and gearbox assembly drives the forward control mechanism, through the cables, to provide stabilizer position indication and rotate the trim wheels. Manual control is accomplished by rotating either trim wheel on the control stand. Operation of the forward control mechanism drives the jackscrew and gearbox assembly via the cables to position the stabilizer.

3 Stabilizer Trim Indication

When the forward control mechanism moves, it drives a jackshaft through a flexible cable which transmits motion to a linkage that positions the indicator needle.

4 Stabilizer Trim Switches

Two stabilizer trim switches are installed for main electric trim control. The switches are on the outboard side of each control wheel. This gives electric input to the stabilizer trim actuator. The motor operates and drives the gearbox and stabilizer jackscrew.

5 Column Cutout Switches

There are two Column Switching Modules. The column cutout switches stop the stabilizer trim when the control column is moved in a direction opposite the trim direction.

6 Stabilizer Trim Cutout Switches

The stabilizer trim cutout switches are used to stop the stabilizer trim actuator.

7 Stabilizer Trim Override Switch

The pilots use the stabilizer trim override switch to bypass the column cutout switches.

8 Stabilizer Trim Limit Switches

The stabilizer trim limit switches limit the range of stabilizer motion (airplane nose up/down) during main electric trim and autopilot trim operation. There are different limits for manual, autopilot, and for flaps up and flaps down. The takeoff warning switches tell the pilot of incorrect stabilizer position at takeoff (out of green band).

9 Stabilizer Trim Actuator

The stabilizer trim actuator is a multispeed, 115 volt, three phase, 400 Hz AC motor. The flaps up switch (S245) on the Flap Control Unit controls the speed of trim actuator. When the flaps are up, the low speed trim mode is engaged.

10 Stabilizer

The horizontal stabilizer assembly consists of a left and right section attached to a center section. The horizontal stabilizer moves a total of 17.1 degrees in these directions:

- 4.2 degrees stabilizer leading edge up (airplane nose down trim)
- 12.9 degrees stabilizer leading edge down (airplane nose up trim).

11 Neutral Shift Mechanism

When the stabilizer moves, it moves the two elevator neutral shift rods. The neutral shift rods provide an input to the elevators through the mach trim actuator, the feel and centering unit, and the elevator input torque tube to the PCUs. When the elevator input torque tube moves, it also backdrives the control cables which move the control columns to their new neutral position.

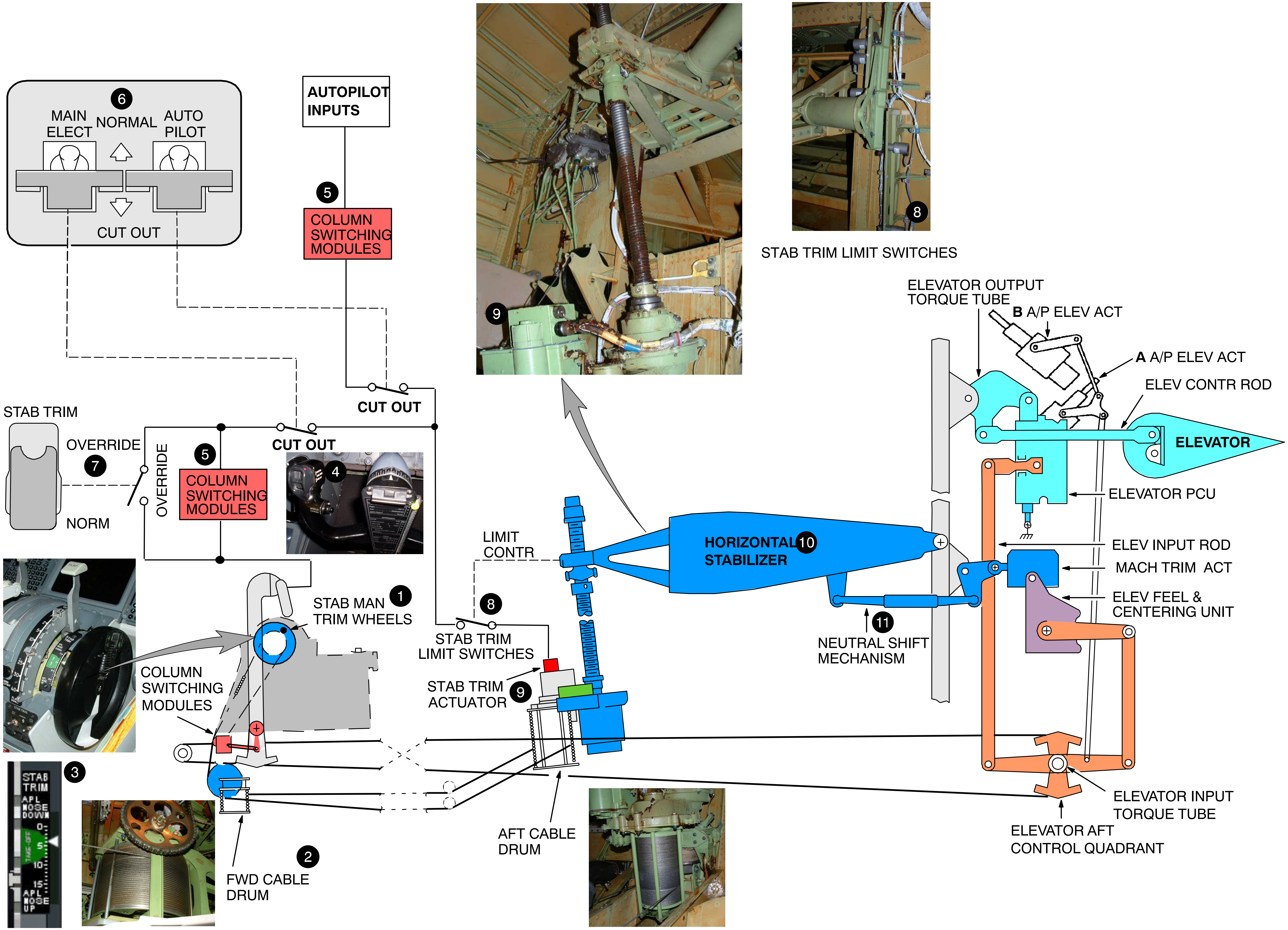


Figure 34 Horizontal Stabilizer Trim Control System Basic Schematic

Reference to Figure 35 TE Flap System Basic System

27-51 TE FLAP SYSTEM

SYSTEM DESCRIPTION

For normal operation, the flap lever makes the commands to the TE flaps to move. The flap lever moves a cable system that supplies a mechanical input to a flap control valve in the flap control unit. The flap control valve sends system B hydraulic power through the bypass valve to the flap PDU (**P**ower **D**rive **U**nit). The PDU moves the flap drive system to move the TE flaps. The PDU supplies a mechanical feedback to the flap control valve as the flap drive system moves. The flap PDU also supplies a mechanical input to the leading edge devices control valve and the flap limit switches in the flap control unit.

If hydraulic power is not available, you can manually select alternate operation. During alternate operation, the alternate flaps switches make the command to the flaps and electrical power moves them.

1 Flap Lever

The flap lever is a spring loaded, telescoping handle. It attaches to the flap lever quadrant in the control stand. The quadrant moves the flap cables that supply inputs to the flap control unit. The flap lever position sensor sends flap lever position data to the FSEU for the T/E Flaps UCM detection functions. The flap lever position switches monitor flap lever position for the flap load relief function and the L/E Devices UCM (**U**n**c**ommanded **M**otion) function.

2 Flap Control Unit

The flap control unit receives mechanical inputs from the flap lever and sends hydraulic power to the T/E PDU and the L/E Device actuators. Also, it controls the four T/E flap position switches.

The TE flap control valve receives mechanical and electrical inputs and sends hydraulic power to the flap PDU. The flap load relief solenoid is on the TE flap control valve. When this solenoid energizes, the TE flaps retract from the flaps 40 or 30 positions to the next lower position.

3 Flap Priority Valve and Flow Limiter

The TE flap priority valve and the flow limiter control the flow of hydraulic fluid to the TE flap hydraulic components. The priority valve gives priority of system B hydraulic power to the LE devices over the TE flaps if If the system B hydraulic pressure is less than 2400 psi. The flow limiter limits the hydraulic fluid flow to 14 gpm this limits the speed of movement of the TE flaps.

4 Flap Power Drive Unit

The TE PDU uses hydraulic or electric power to turn the TE flap torque tubes and the follow up cables. The flap PDU has these components:

- Gearbox
- Hydraulic motor
- Electric motor

There is a manual drive connection on the flap PDU that lets you manually move the TE flaps.

5 Trailing Edge Flap Bypass Valve

The TE flap bypass valve prevents the hydraulic operation of the TE flaps during these conditions:

- Alternate flap operation
- TE flap skew
- TE flaps asymmetry
- TE flaps UCM.

When the bypass valve is in the normal position, it permits hydraulic power from the flap control valve to go to the TE flap hydraulic motor.

6 Alternate Flaps Switches

During the alternate operation, the alternate flaps switches control the TE flap electric motor and flap bypass valve. When you move the alternate flaps arm switch to the ARM position, electrical power becomes available to the alternate flaps control switch (Note: The standby hydraulic pump motor operates when the alternate flap arm switch is in the ARM position).

When you move and hold the alternate flaps control switch in the DOWN position, the TE flap electric motor receive electrical power. The electric motor moves the TE flaps until you release the switch or move it to the OFF position.

7 Torque Tubes and Torque Tube Supports

The flap torque tubes transmit power from the TE flap PDU, through the angle gearboxes, to the flap transmissions. There are 16 torque tubes of different lengths for the flap drive system. There is one torque tube support between the two outboard flap transmissions on each wing.

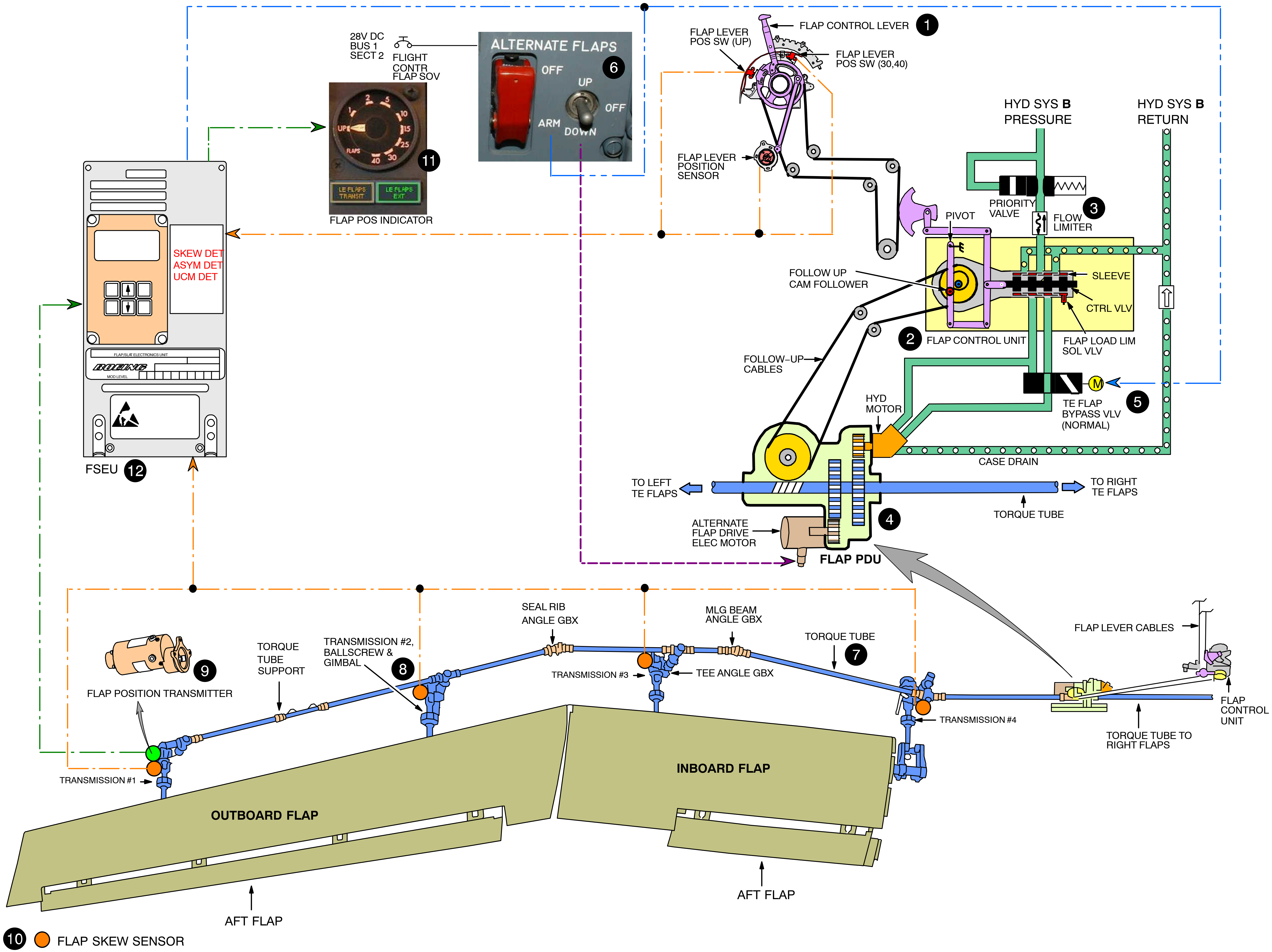


Figure 35 TE Flap System Basic System

Reference to Figure 36 TE Flap System Basic System Cont.

TE FLAP SYSTEM BASIC CONT.

8 Flap Transmissions, Ballscrews and Gimbals

Each TE flap transmission transmits the power from the torque tubes to the universal joint and ballscrew. When the ballscrew moves, the gimbal moves. This causes the TE flap to move. Each transmission has a torque brake that prevents excessive loads on the ballscrew if the flap does not move freely. The torque brake operates in either direction of flap movement. Each transmission also has two no back brakes. The no back brakes prevent TE flaps retraction because of airloads. The transmission turns the ballscrew through the universal joint. The ballscrew has a ballscrew nut which connects to the gimbal. As the ballscrew turns, the ballscrew nut moves the gimbal. The gimbal moves the TE flap surface. The gimbal connects to the ballscrew nut and moves as the ballscrew turns.

9 Flap Position Transmitters

There are two flap position transmitters. The flap position transmitters send flap position data to these components:

- FSEU
- FCCs (2)
- SMYDs (2)

The FSEU uses the flap position data to control the left and right needles in the flap position indicator.

10 Flap Skew Sensors

The flap skew sensors send flap position data to the FSEU. The FSEU uses this data to monitor the alignment of the TE flaps. There are eight flap skew sensors. There is one sensor at each flap drive mechanism. The FSEU compares the data from symmetrical sensors. If the difference in the position of two symmetrical sensors is more than a limit, then there is a skew condition. The FSEU sends electrical power to the T/E flap bypass valve. This stops the hydraulic operation of the TE flaps. Also the FSEU sends an input to the flap position indicator to split the needles 15 degrees.

11 Flap Position Indicator

The flap position indicator shows the position of the left and right wing TE flaps independently. The flap position indicator has left and right needles to show the position of the left and right wing TE flaps independently.

12 Flap Slat Electronics Unit

The FSEU (**F**lap/**S**lat **E**lectronics **U**nit) supplies some control and monitor functions for the TE flaps and the LE devices. The FSEU can help you find and isolate a failure in the TE flap system and the LE flap and slat system. Front panel BITE on the FSEU lets you interface with the BITE functions in the FSEU.

The FSEU includes these functions for the TE flaps and LE devices:

- TE flap position indication
- TE flap load relief
- TE flap skew and asymmetry detection
- TE flap uncommanded motion detection
- LE flap and slat position indication
- LE cruise depressurization
- LE flap and slat uncommanded motion detection
- BITE

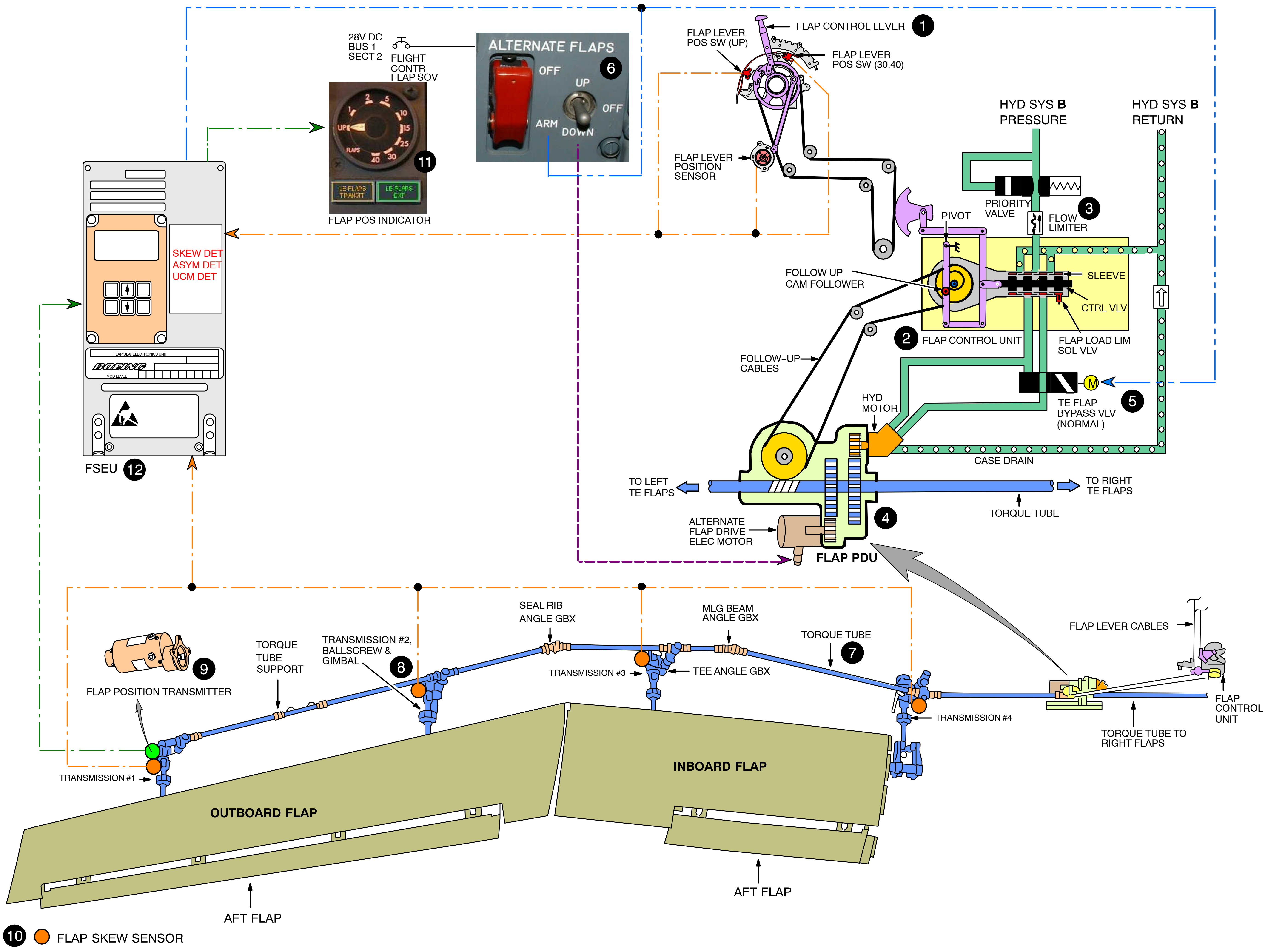


Figure 36 TE Flap System Basic System Cont.

Reference to Figure 37 LE. Flap & Slat Sys. Schematic

27-81 LE FLAP & SLAT CONTROL SYSTEM

SYSTEM DESCRIPTION

The LE devices include two Krueger flaps and four slats on the leading edge of each wing. During cruise, these surfaces fully retract. These surfaces extend during takeoff to increase lift, which permits slower speeds for airplane rotation. During landing, the LE slats fully extend to increase lift and help prevent a stall. During the normal operation, the LE flaps and slats are mechanically controlled. During the alternate operation, the LE flaps and slats are electrically controlled.

1 LE Flap & Slat Control Valve

The TE flap PDU gives mechanical inputs to the LE flap and slat control valve during normal operation. The flap lever moves a cable system that supplies a mechanical input to the TE flap system. This inputs move the LE flap and slat control valve. The LE flap and slat control valve receives hydraulic system B pressure from the LE cruise depressurization valve. It sends hydraulic power through the autoslat control valve to the extend lines of the LE flap and slat actuators.

2 LE Cruise Depressurization Valve

The LE cruise depressurization valve is normally open. This permits hydraulic system B pressure to the LE flap and slat control valve. The LE flap and slat control valve sends this pressure to the extend lines of the LE flap and slat actuators. It closes when all these conditions occur for 5 seconds:

- Airplane in air
- Flap lever at up
- LE flaps and slats at up.

It does not operate if the alternate flaps arm switch is in the ARM position.

3 LE Uncommanded Motion Shutoff Valve

The LE UCM shutoff valve prevents LE flap and slat movement if two or more LE flaps or slats move away from their commanded position. It is normally open. This permits hydraulic system B pressure to the retract lines of the LE flap and slat actuators. The valve closes when all the LE flaps and slats move to their commanded position and then these conditions occur:

- Two or more LE flaps or slats move away from the flap lever position
- Flap lever is in a detent.

This stops the hydraulic system B pressure to the retract lines of the LE flap and slat actuators. This prevents movement of the LE flaps and slats. The function is not available if the airplane speed is less than 60 knots or if the alternate flaps arm switch is at ARM.

4 Autoslat Control Valve

The autoslat control valve causes the LE slats to move from extend to full extend if the airplane gets near a stall condition. This valve supplies pressure to the full extend port on the LE slat actuators. The autoslat operation occurs when all of these conditions occur:

- Flap lever at 1, 2 or 5
- Airplane gets near a stall condition
- Alternate operation is not active.

When all of these conditions occur, the SMYDs energize the two solenoids. The solenoid valves send extend pressure to the pressure. operated valves. This permits either pressure. operated valve to send extend pressure to the full extend port on the LE slat actuators. If one valve, solenoid, or SMYD has a failure, the pressure still goes to the actuators.

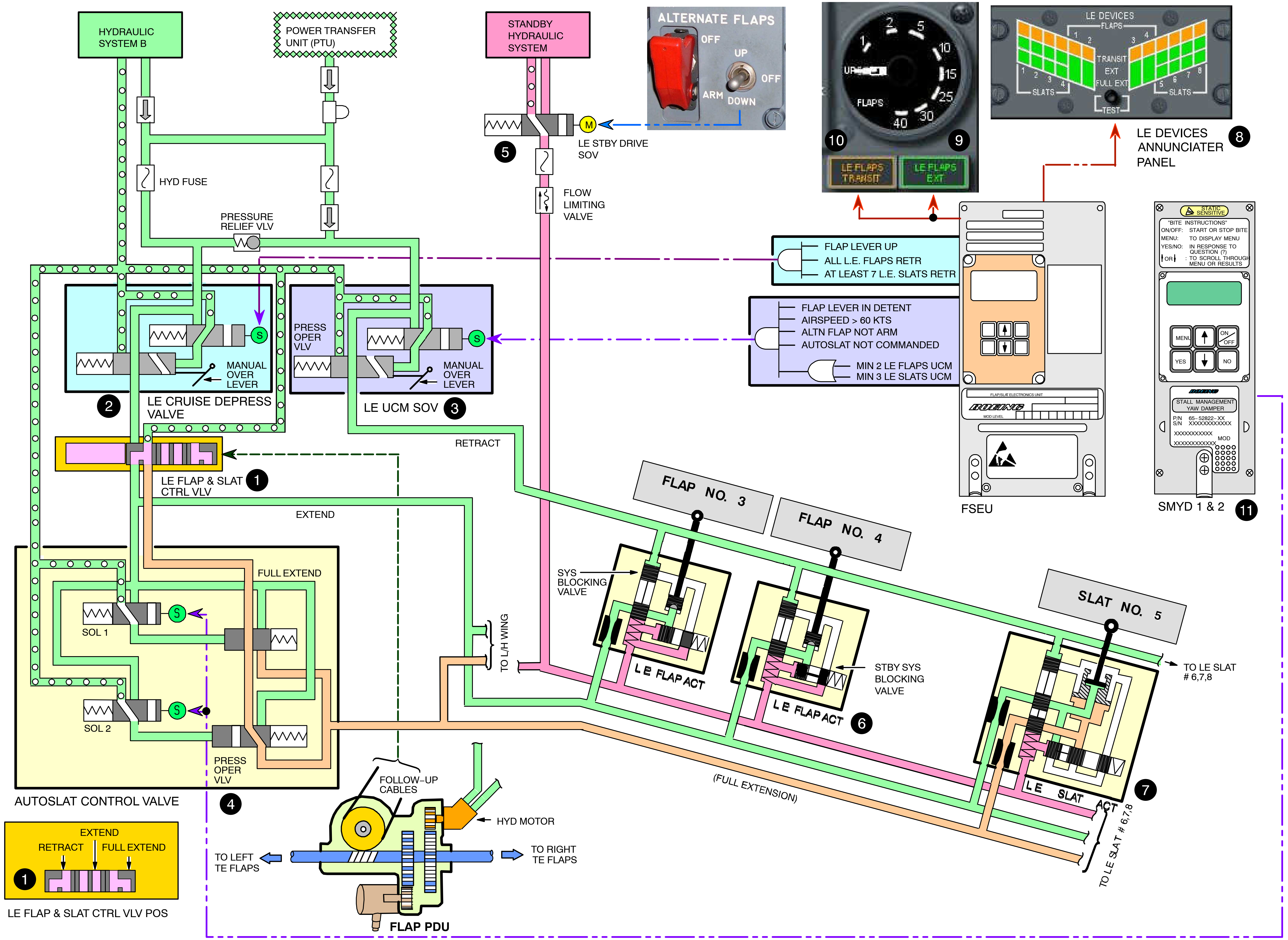


Figure 37 LE. Flap & Slat Sys. Schematic

Reference to Figure 38 LE. Flap & Slat Sys. Schematic (Cont.)

5 LE Standby Drive Shutoff Valve

When the alternate flaps arm switch is in the ARM position, electrical power becomes available to the alternate flaps control switch. The ARM switch supplies signals to the standby hydraulic system to operate the standby hydraulic pump. When the alternate flaps control switch is in the down position, the LE The LE standby shutoff valve opens. If the PTU was operating, it stops. The standby hydraulic pressure supplies pressure to the LE flap and slat actuators, and these actuators extend. The LE flaps move to the extend position and the LE slats move to the full extend position.

During the alternate operation, the LE flaps and slats can not retract. You must use the normal operation to retract the surfaces.

6 LE Flap Actuators

During extension in the normal operation, the actuator receives retract pressure from hydraulic system B and extend pressure from the LE flap and slat control valve. This causes the system blocking valve to open, which permits pressure to both sides of the piston. When the pressure is the same on both sides of the piston, the piston extends.

7 LE Slat Actuators

During the normal operation, hydraulic system B supplies hydraulic power to the LE slat actuators. The LE flap and slat control valve supplies extend pressure to the LE slat actuators. Hydraulic system, B supplies retract pressure to the LE slat actuators. During the alternate operation, the standby system supplies hydraulic power to the LE slat actuators to fully extend the LE slats. The LE slats do not retract during the alternate operation. The LE slat actuators have the three positions: Retract, Extend and Full Extend.

8 LE Devices Annunciator Panel

When the LE flaps and slats are in the retract position, all the lights go out of view. When the surfaces move, the transit lights show. When the surfaces are in the extend position, the extend lights show. When the LE slats are in the full extend position, the full extend lights show. There is a test switch on the LE devices annunciator panel. When you push this switch, all the lights show.

9 LE FLAPS EXT Light

The LE FLAPS EXT light green shows green when all of the LE flaps and slats are in an extend or full extend position.

10 LE FLAPS TRANSIT Light

The LE FLAPS TRANSIT light shows amber when a LE flap or slat is not in the correct position or when a LE UCM (**U**n**c**ommanded **M**otion) occurs.

11 Stall Management Yaw Damper

Two SMYD (**S**tall **M**anagement **Y**aw **D**amper) computers calculate the autoslat commands. Each SMYD sends an autoslat signal to the autoslat control valve. The autoslat control valve sends hydraulic power from hydraulic system B to the LE slat actuators. This causes the LE slats to fully extend.

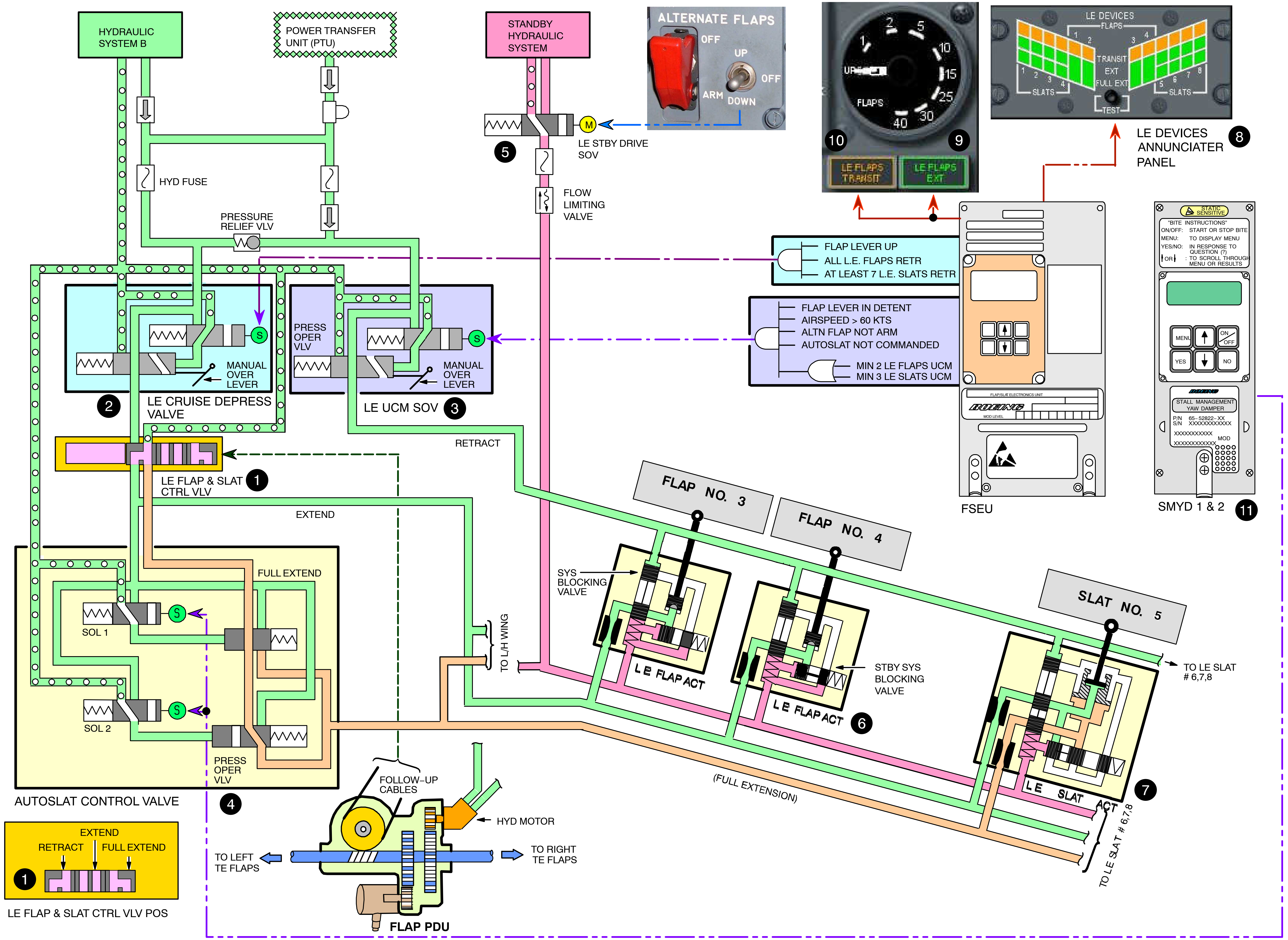


Figure 38 LE. Flap & Slat Sys. Schematic (Cont.)

Reference to Figure 39 Fuel System Basic Schematic

ATA 28 FUEL

28-00 GENERAL

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The fuel tanks store fuel for use by the engines and the APU. The pressure fueling system lets you add fuel to each tank. The fueling station is on the right wing. You also do defueling and fuel transfer at the fueling station.

Control of the engine and APU fuel feed system is on the P5 panel. Fuel quantity of each tank shows in the flight compartment and at the fueling station.

BITE is available to maintenance personnel through the CDU (**C**ontrol **D**isplay **U**nit).

1 Fuel Panel

The fuel panel is on the P5 overhead panel. Switches on the panel control the boost pumps and the crossfeed valve.

Boost pump LOW PRESSURE lights come on when boost pump pressure is low.

Center tank boost pump LOW PRESSURE lights come on when the center tank boost pump switch is in the ON position and center tank boost pump pressure is low.

FUEL VALVE CLOSED lights come on dim when the engine fuel spar valve is closed. The FUEL VALVE CLOSED lights come on bright when there is a disagreement between the switch and valve position. The FUEL VALVE CLOSED lights are off when the engine fuel spar valve is open.

The crossfeed VALVE OPEN light comes on dim when the crossfeed valve is open. The crossfeed VALVE OPEN light comes on brightly when there is a disagreement between the switch and valve position. The crossfeed VALVE OPEN light is off when the crossfeed valve is closed.

2 Fueling Panel P15

The blue valve position lights come on when the fueling shutoff valve solenoids have power. The light does not show that the fueling valve is open.

The fueling valve control switches are two-position switches. The fueling valve solenoid energizes when you put the switch in OPEN and power is available. The valve opens if fuel pressure is available at the fueling manifold. In the CLOSED position, the fueling valve solenoid de-energizes and the valve closes.

3 Fueling Valves

The fueling valves control fuel flow to the fuel tanks. A solenoid controls the valve while fuel pressure operates the valve. A manual override plunger on each valve permits manual operation.

4 Fueling Float Switches

The fueling float switches prevent over-fueling the fuel tanks.The fueling float switches remove power to the fueling valves when the fuel level in the tank is full.

5 Center Tank Boost Pumps

The center tank boost pumps supply fuel from the center tank to the engine fuel feed manifold.

6 Main Tank Fwd And Aft Boost Pumps

The boost pumps supply fuel from main tanks to the engine feed manifold.

7 Engine Fuel Pump

The engine fuel pump supplies pressurized fuel to the servo and metering sections of the HMU.

8 Engine Fuel Spar Valve

The engine fuel spar valves control fuel flow to the engines. The engine start levers and the engine fire switches control the engine fuel spar valves.

9 Crossfeed Valve

The crossfeed valve lets fuel flow between the left and right engine fuel feed manifolds. With the connection of the two engine fuel feed manifolds, one fuel tank supplies fuel to both engines.

10 Defuel Valve

The defuel valve connects the right engine fuel feed manifold with the defuel manifold. This permits removal of fuel from the fuel tanks.

11 APU Fuel Shutoff Valve

The APU fuel shutoff valve lets fuel flow from the left engine fuel feed manifold to the APU.

12 Fuel Quantity Indicating System

The FQIS (**F**uel **Q**uantity **I**ndicating **S**ystem) measures the fuel volume in the fuel tanks. The FQIS also calculates the fuel weight in the fuel tanks.

These are the FQIS components:

- Fuel quantity processor unit
- Tank units
- Compensators
- Wiring harnesses.

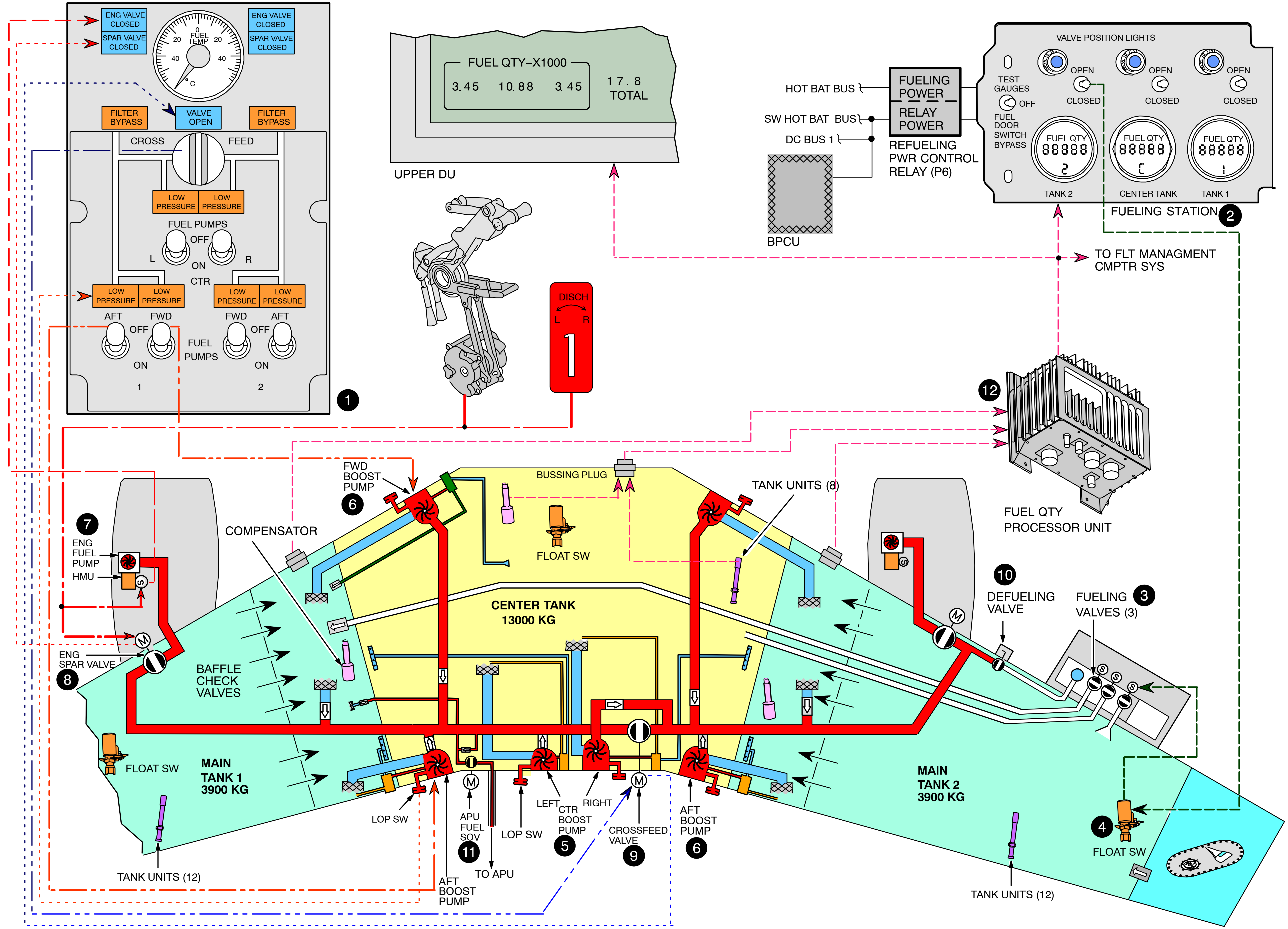


Figure 39 Fuel System Basic Schematic

Reference to Figure 40 Hydraulic Basic Schematic

ATA 29 HYDRAULIC

29-00 GENERAL

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

There are three independent hydraulic systems that supply hydraulic power for user systems A, B and Stby.

The two main hydraulic systems are A and B. The auxiliary systems are the standby hydraulic system and the PTU (**P**ower **T**ransfer **U**nit).

1 Hydraulic Reservoir Pressurization System

The hydraulic reservoir pressurization system supplies air from the pneumatic system to the reservoir. This pressurizes the supply hydraulic fluid for the pumps.

2 Hydraulic Reservoirs

The hydraulic reservoirs supply hydraulic fluid under pressure to the hydraulic pumps. The reservoirs also get the return fluid from the airplane systems that use hydraulic power.

3 EDP Supply Shutoff Valve

The supply shutoff valve for stops hydraulic fluid flow from the reservoir to the EDP when you move the fire switch to the up position.

4 Engine Driven Pump (EDP)

The EDP operates when the related engine turns. To stop output flow from the EDP, move the HYD PUMP switch on the hydraulic panel to the OFF position. This does not stop the rotation of the pump or the internal pressure in the pump.

5 Electric Motor Driven Pump (EMDP)

The EMDP is driven by an oil-cooled, three-phase, 115VAC motor. An acoustic filter is in the pressure line.

6 Pressure Module

The pressure module distributes hydraulic pump pressure to the user systems, cleans pressure fluid from the EDP and EMDP, monitors EDP and EMDP pressure, monitors system pressure and includes high pressure system protection.

7 Heat Exchanger

The heat exchanger is located in the main fuel tank. It cools the hydraulic case drain fluid from the pumps before the fluid goes back to the reservoir.

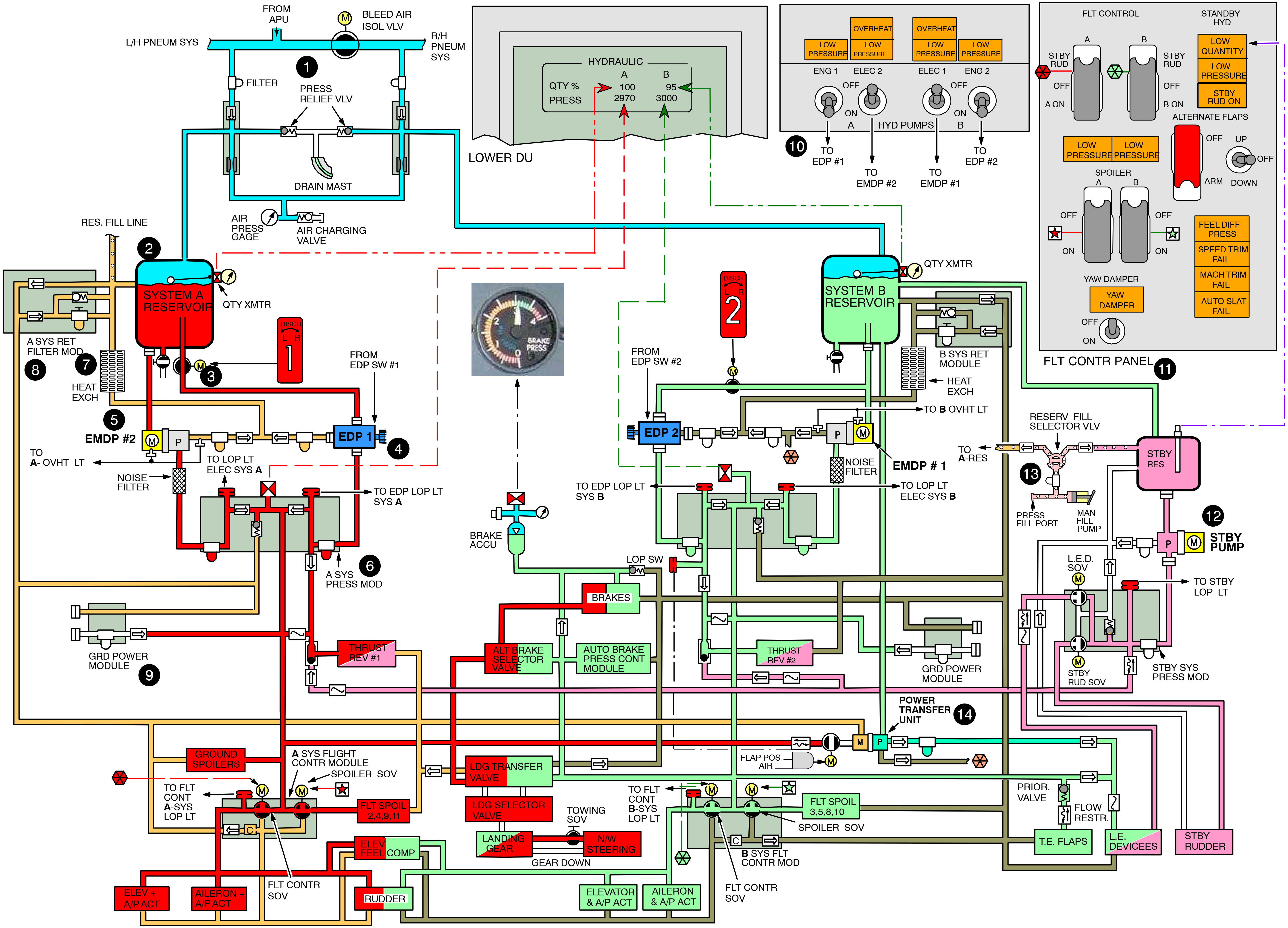


Figure 40 Hydraulic Basic Schematic

Reference to Figure 41 Hydraulic Basic Schematic (Cont.)

8 Return Filter Module

The return filter modules clean the return hydraulic fluid from the EDP or EMDP (**E**lectric **M**otor-**D**riven **P**umps) before it goes back to the reservoirs.

9 Ground Power Module

The ground power module permits you to pressurize the hydraulic systems A and B from a ground service cart.

10 Hydraulic Panel

The EDP and the EMDP each have a switch on the hydraulic panel. The ENG hydraulic pump switch controls the EDP. The ELEC hydraulic pump switch controls the EMDP.

LOW PRESSURE amber lights for each EDP and EMDP come on when the pump output pressure is less than normal. OVERHEAT amber lights for each EMDP come on when the case drain fluid temperature increases to more than normal or the EMDP motor part is overheated.

11 Flight Control Panel

The LOW QUANTITY light to the right of the FLT CONTROL switches comes on when the stby system hydraulic fluid quantity decreases to less than normal in the standby hydraulic system reservoir. The LOW PRESSURE light illuminates when the stby system pressure is low and stby pump operation has been commanded. The STBY RUD ON light illuminates when the stby hydraulic system supplies the rudder.

12 Standby Hydraulic System

The pressure source for the standby hydraulic system is an EMDP. The standby hydraulic system operates as an alternative system. You operate the standby system manually with the FLT CONTROL switches to STBY RUD position or the ALTERNATE FLAPS arm switch to ARM position. The standby pump operates automatically if all of these conditions are true:

- One FLT CONTROL switch to ON
- Trailing edge flaps not up
- Airplane in the air or wheel speed more than 60 knots
- Low flight control pressure (primary controls).

or the FFM (**F**orce **F**ight **M**onitor) circuit has been activated.

13 Ground Service Fill Station

The ground service system fills all hydraulic reservoirs from one central location. The reservoirs can be filled with either of these procedures: Manual fill, ground hydraulic chart.

14 POWER TRANSFER UNIT (PTU)

The hydraulic PTU is a hydraulic motor pump that supplies an alternative source for power for the operation of leading edge flaps and slats. The PTU system operates automatically when these conditions occur:

- Airplane in the air
- Trailing edge flap position between up and 15
- System B EDP low pressure.

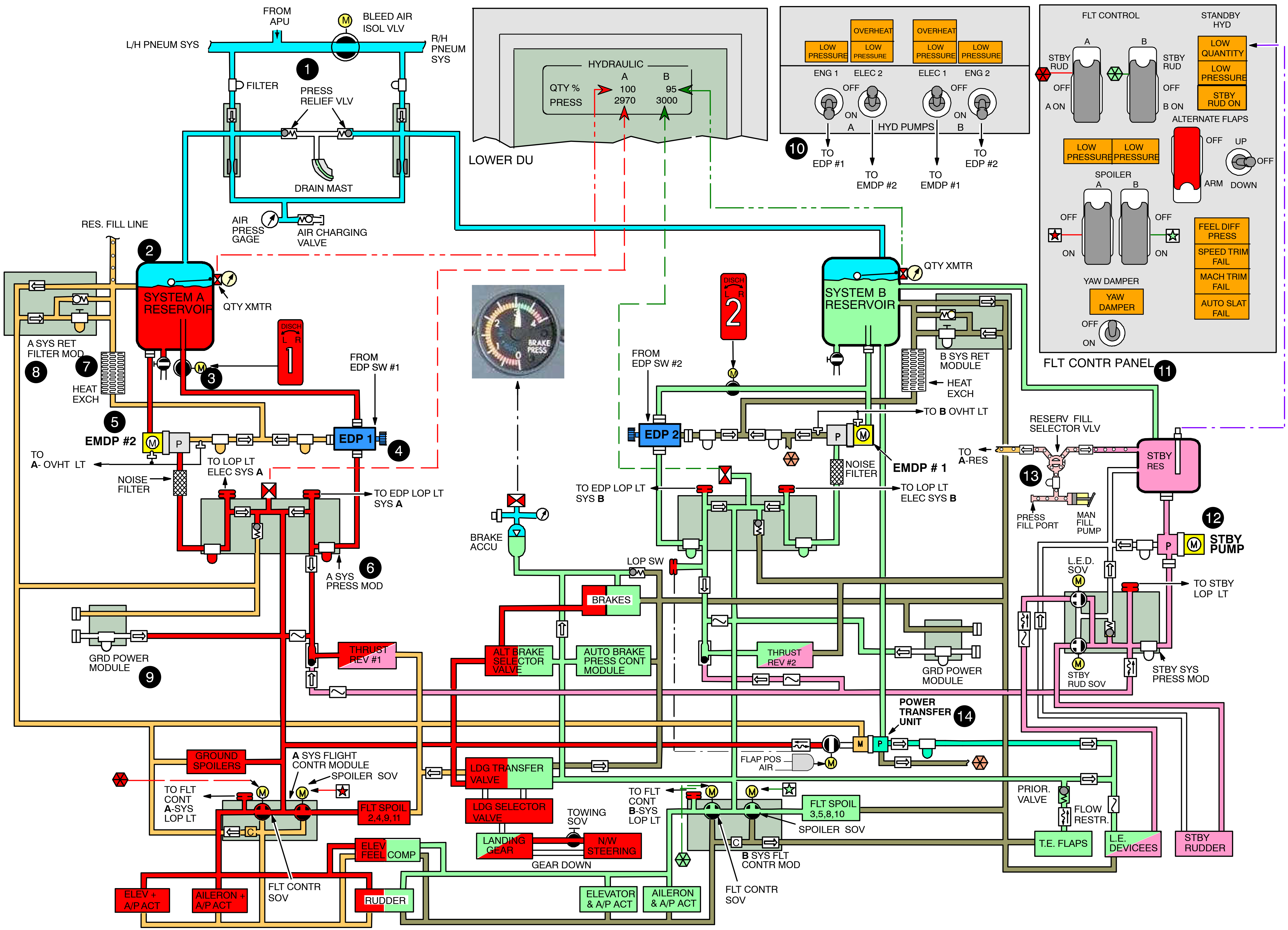


Figure 41 Hydraulic Basic Schematic (Cont.)

Reference to Figure 42 Hydraulic System General

29-00 GENERAL

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

There are three independent hydraulic systems that supply hydraulic power for user systems A, B and Stby.

The two main hydraulic systems are A and B. The auxiliary systems are the standby hydraulic system and the PTU.

1 Hydraulic Reservoir Pressurization System

The hydraulic reservoir pressurization system supplies air from the pneumatic system to the reservoir. This pressurizes the supply hydraulic fluid for the pumps.

2 Hydraulic Reservoirs

The hydraulic reservoirs supply hydraulic fluid under pressure to the hydraulic pumps. The reservoirs also get the return fluid from the airplane systems that use hydraulic power.

3 EDP Supply Shutoff Valve

The supply shutoff valve for stops hydraulic fluid flow from the reservoir to the EDP when you move the fire switch to the up position.

4 Engine Driven Pump (EDP)

The EDP operates when the related engine turns. To stop output flow from the EDP, move the HYD PUMP switch on the hydraulic panel to the OFF position. This does not stop the rotation of the pump or the internal pressure in the pump.

5 Electric Motor Driven Pump (EMDP)

The EMDP is driven by an oil-cooled, three-phase, 115VAC motor. An acoustic filter is in the pressure line.

6 Pressure Module

The pressure module distributes hydraulic pump pressure to the user systems, cleans pressure fluid from the EDP and EMDP, monitors EDP and EMDP pressure, monitors system pressure and includes high pressure system protection.

7 Heat Exchanger

The heat exchanger is located in the main fuel tank. It cools the hydraulic case drain fluid from the pumps before the fluid goes back to the reservoir.

8 Return Filter Module

The return filter modules clean the return hydraulic fluid from the EDP or EMDP before it goes back to the reservoirs.

9 Ground Power Module

The ground power module permits you to pressurize the hydraulic systems A and B from a ground service cart.

10 Standby Hydraulic System

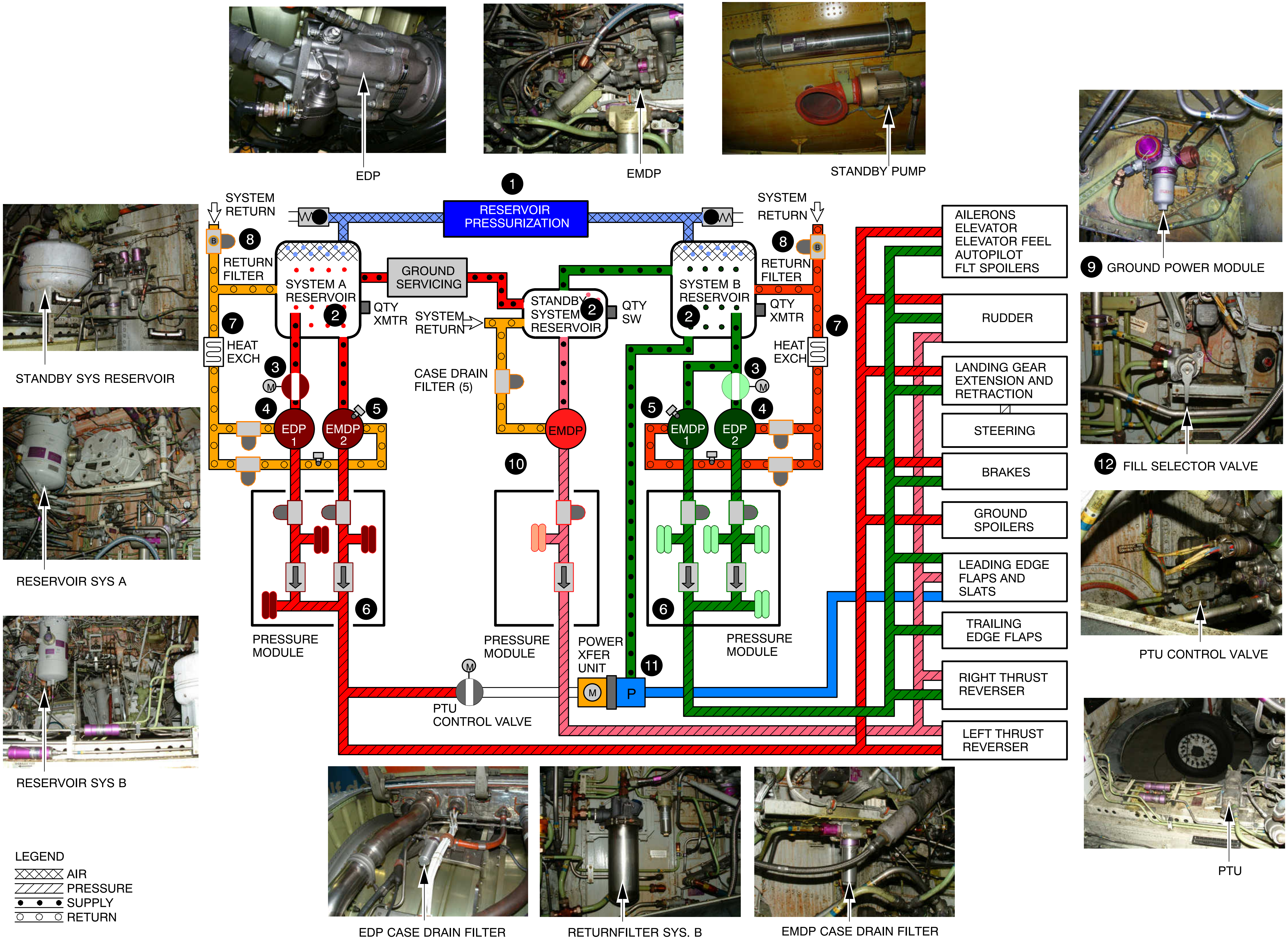
The pressure source for the standby hydraulic system is an EMDP. The standby hydraulic system operates as an alternative system. You operate the standby system manually with the FLT CONTROL switches to STBY RUD position or the ALTERNATE FLAPS arm switch to ARM position. The standby pump operates automatically too.

11 Power Transfer Unit (PTU)

The PTU is a hydraulic motor pump that supplies an alternative source for power for the operation of leading edge flaps and slats. The PTU system operates automatically.

12 Ground Service Fill Station

The ground service system fills all hydraulic reservoirs from one central location. The reservoirs can be filled with either of these procedures: Manual fill, ground hydraulic chart.


EDP
EMDP
STANDBY PUMP
1
RESERVOIR PRESSURIZATION
SYSTEM RETURN
8
RETURN FILTER
SYSTEM A RESERVOIR
2
QTY XMTR
GROUND SERVICING
SYSTEM RETURN
STANDBY SYSTEM RESERVOIR
QTY SW
SYSTEM B RESERVOIR
7
HEAT EXCH
3
M
4
EDP 1
EMDP 2
5
CASE DRAIN FILTER (5)
EMDP
10
6
PRESSURE MODULE
POWER XFER UNIT
11
P
PTU CONTROL VALVE
AILERONS
ELEVATOR
ELEVATOR FEEL
AUTOPILOT
FLT SPOILERS
RUDDER
LANDING GEAR EXTENSION AND RETRACTION
STEERING
BRAKES
GROUND SPOILERS
LEADING EDGE FLAPS AND SLATS
TRAILING EDGE FLAPS
RIGHT THRUST REVERSER
LEFT THRUST REVERSER
STANDBY SYS RESERVOIR
RESERVOIR SYS A
RESERVOIR SYS B
9 GROUND POWER MODULE
12 FILL SELECTOR VALVE
PTU CONTROL VALVE
PTU
EDP CASE DRAIN FILTER
RETURNFILTER SYS. B
EMDP CASE DRAIN FILTER
LEGEND
AIR
PRESSURE
SUPPLY
RETURN

Reference to Figure 43 Ice&Rain Protection-Overview

ATA 30 ICE&RAIN PROTECTION

30-00 GENERAL

SYSTEM DESCRIPTION

GENERAL

The ice and rain protection system prevents ice formation from the subsequent airplane parts:

- Wing Leading Edges (pneumatically de-iced)
- Engine Inlet Cowls (pneumatically de-iced)
- Air Data Probes (electrically de-iced)
- Flight Compartment Windows (electrically de-iced)
- Water & Waste System Lines and Drains (electrically de-iced)

1 Control Panel

The controls and indications for the ice and rain protection system are on the P-5 panel.

2 Probe Heat

The air data probes use electric heat to prevent ice.

3 Flight Deck Window

Flight deck windows use electric heat to do these things:

- Prevent ice formation on the windows
- Prevent fog on the windows
- Improve windshield impact strength.

The windshields have these features to improve forward vision in heavy rain:

  - Windshield wipers
  - Hydrophobic (rain repellent) coatings.

4 Drain and Water Line Heating

Electric heaters prevent freezing in the water and waste systems components.

ABBREVIATIONS AND ACRONYMS

- CTAI (**C**owl **T**hermal **A**nti-**I**ce)
- TAI (**T**hermal **A**nti-**I**ce)
- WHCU (**W**indow **H**eat **C**ontrol **U**nit)
- WTAI (**W**ing **T**hermal **A**nti-**I**ce)

NOTE: Only the electrically de-iced systems will be discussed in this section of the training manual.

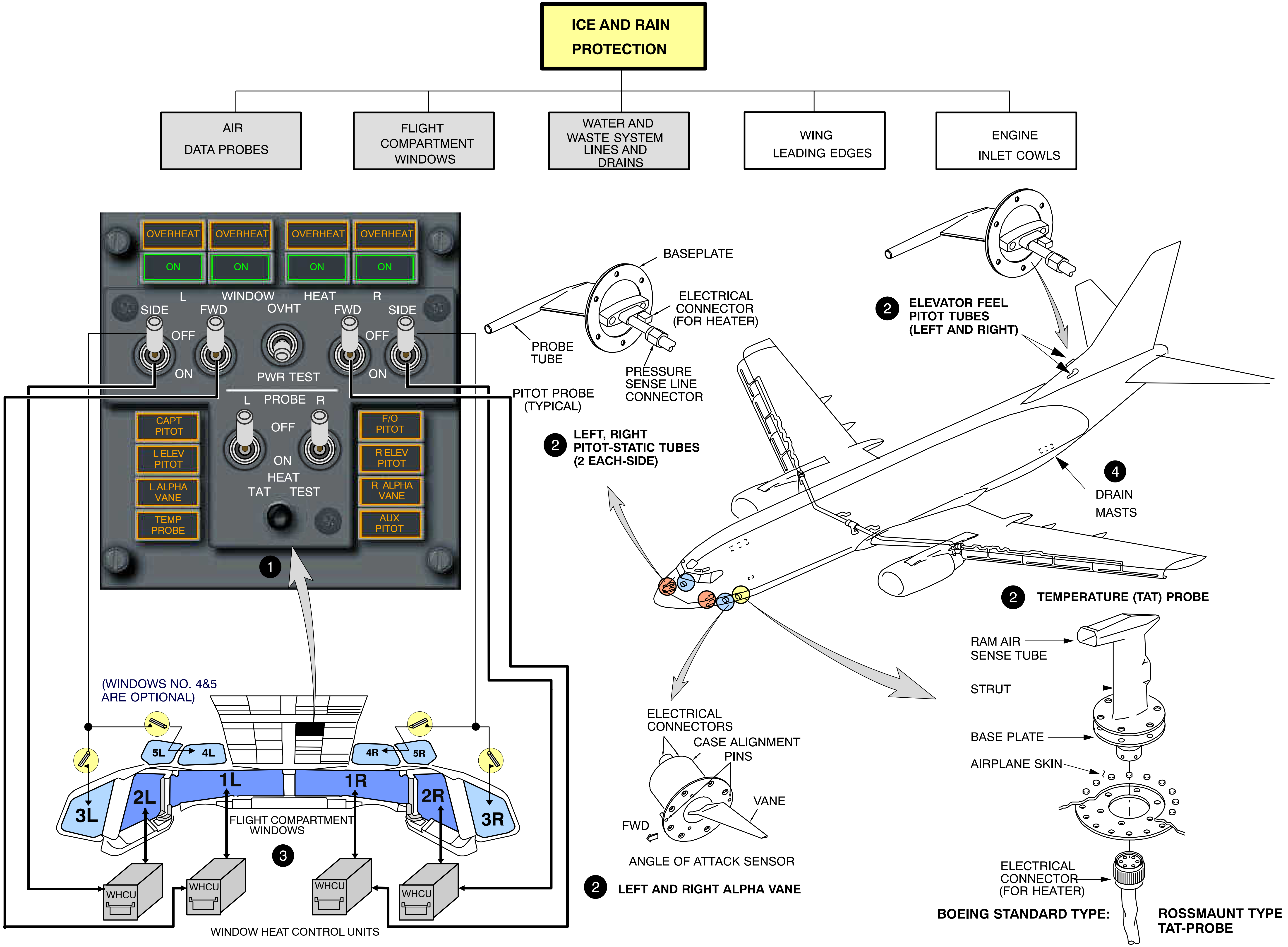


Figure 43 Ice&Rain Protection-Overview

Reference to Figure 44 TAT Probe, Pitot Probe and Alpha Vane – Description

30−30 PITOT AND STATIC HEATING

GENERAL

The air data probes use electric power for heat. The probes have integral heaters.
The pitot and static anti−icing system supplies heat to these probes:

- Alpha vanes (2)
- Total air temperature probe (1)
- Pitot probes (5).

The static system sense ports are not part of the probe heat system. These ports are flush with the fuselage and heat is not necessary.
You control the air data probe heat from the control module on the P−5 panel.

1 Pitot And Static−control Panel

The pitot and static control panel (P5−9) does these things:

- Controls the electric power to the pitot and static anti−icing systems.
- Gives the flight crew indication of the pitot and static anti−icing system status.

The air data probe heaters are divided into two systems, A and B.
Two momentarily switches let the crew turn on the heat systems:

- PITOT HEAT A
- PITOT HEAT B

The system indication lights are divided into two banks, one for A system and one for B system.
The lights come on when the probe heaters do not draw electrical current.

TAT test switch

This is a customer option:
This switch is only installed in airplanes with aspirated TAT−probe. So on ground, even with left heater switch in ON, the TAT−probe is not heated.
Nevertheless, the amber OFF−light extinguishes.
With airplane air, the probe automatically is heated.

2 Aspirated Type Tat Probe

The engine bleed air (picked up downstream of the left pack shut off valve) forces ambient air to flow around the sensing element. By this, the probe senses ambient air temperature, even the sun shines and the airplane stopped. So the flight management computer can use the probe temperature for engine power calculations even with stopped airplane. The flight management computer uses even on ground the ambient air temperature for performance calculations. Probe heating on ground would result wrong performance calculations.

3 Pitot Probes

There are five pitot probes on the airplane.
The pitot probes have electric heaters. If a probe heater fails you must replace the entire probe.

4 Alpha Vanes

There are two alpha vanes on the airplane. The alpha vanes have two integral heaters:

- A vane heater
- A case heater.

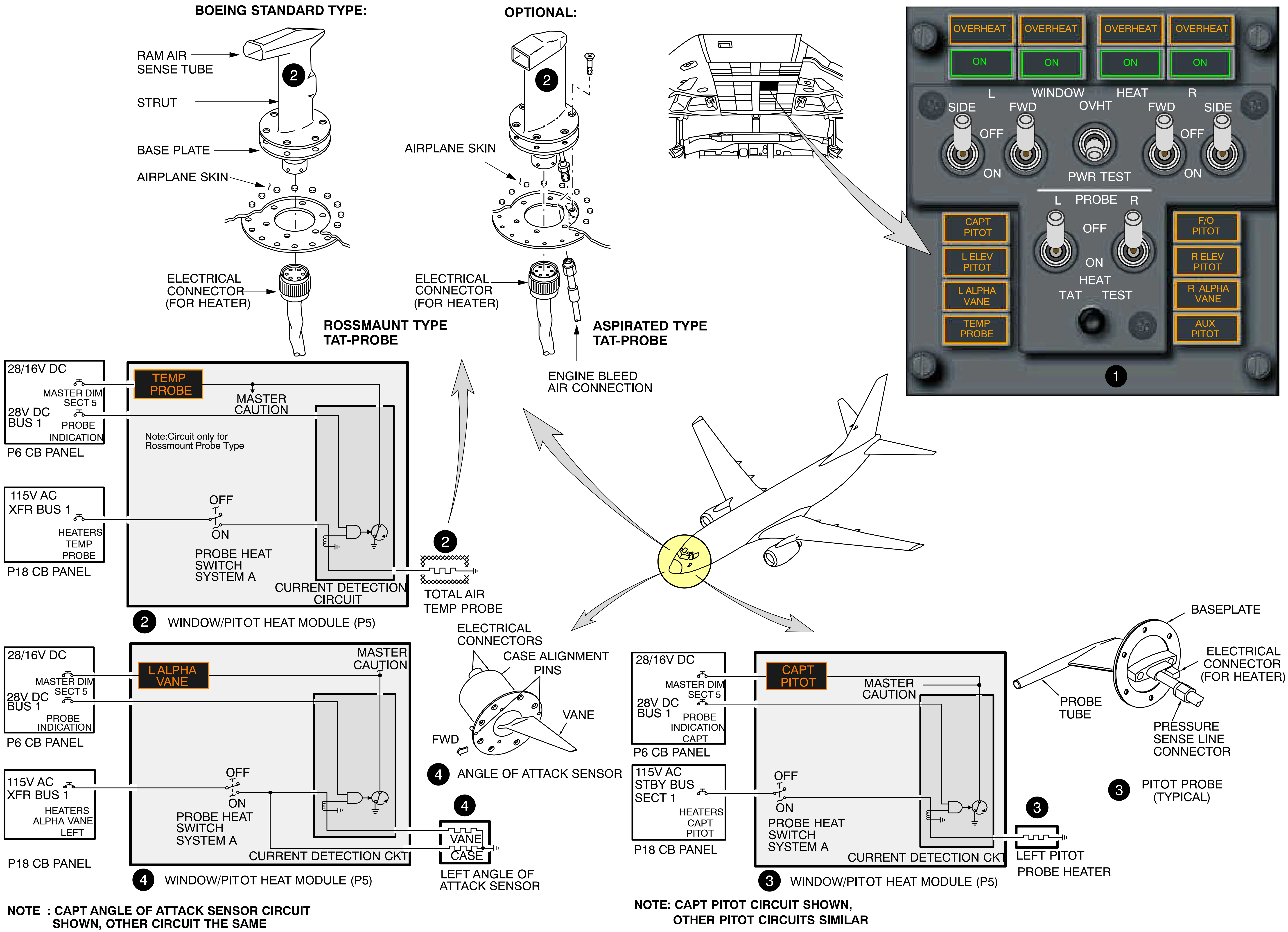


Figure 44 TAT Probe, Pitot Probe and Alpha Vane – Description

Reference to Figure 45 CWAI Logic Block Diagram

30-41 CWAI SYSTEM

GENERAL

The control cabin anti-icing system uses electrical power to heat the flight compartment windows.
The controls and indications for the control cabin window anti-icing system are on the P5-9 panel.
WHCUs (**W**indow **H**eat **C**ontrol **U**nits) are part of the control cabin window anti-icing system.
The WHCUs do these things:

- Monitor window temperature, supply ON and OVERHEAT system indication and test the system.
- The WHCUs control power to these windows:
  - No. 1 Left and right
  - No. 2 left and right.
- Thermal switches monitor window temperature and control power to these windows:
  - No. 3 left and right
  - No. 4 left and right
  - No. 5 left and right.

Windows in the thermal switch control systems are not part of the P5-9 indication and test functions.

1 Window Heat Control

You control window heat from the P5-9 panel.
These four WINDOW HEAT switches control the window heat systems:

- L SIDE
- L FWD
- R SIDE
- R FWD

The SIDE switches turn on and off window heat to their related No. 2, 3, 4, and 5 windows if installed.
Put the WINDOW HEAT switch to ON to energize the window heat system.
Turn the switch OFF to remove power from the system, or to reset an OVERHEAT condition.

2 Window Heat Control Unit

The WHCUs do these things:

- sense window temperature
- apply current to the window heat system when necessary
- control current to the window heat conductive coating to prevent thermal shock
- control the P5-9 window heat status indication
- have circuitry for P5-9 OVHT and PWR TEST

On the ground, the MASTER CAUTION and ANTI-ICE annunciator lights are inhibited for the amber OFF light when left engine throttle is retarded.

3 Temperature Sensors

Windows 1 and 2 have resistance type temperature sensors for feedback to the window heat control units.
There are two sensors in each window:

- A primary sensor
- A spare sensor

4 Thermal Switches

The thermal switch is a normally closed, single pole, snap action bimetallic device. It operates by thermal expansion. The thermal switches are wired in series with the windows they control.
Put the related SIDE WINDOW HEAT switch to ON to energize the system. 115v ac power moves through a thermal switch to the resistive layer of in each window. The resistance of the paste to the current produces heat and warms the window. As the windows get warm, so does the thermal switch, which is on a window. When the switch is at a temperature of 110F (43C) or more, it opens. This opens the circuit, and removes power to the windows.
When the windows and thermal switch temperature decreases to 80F (26C) (nominal), the switch closes and completes the heat circuit. This starts the window heat again.

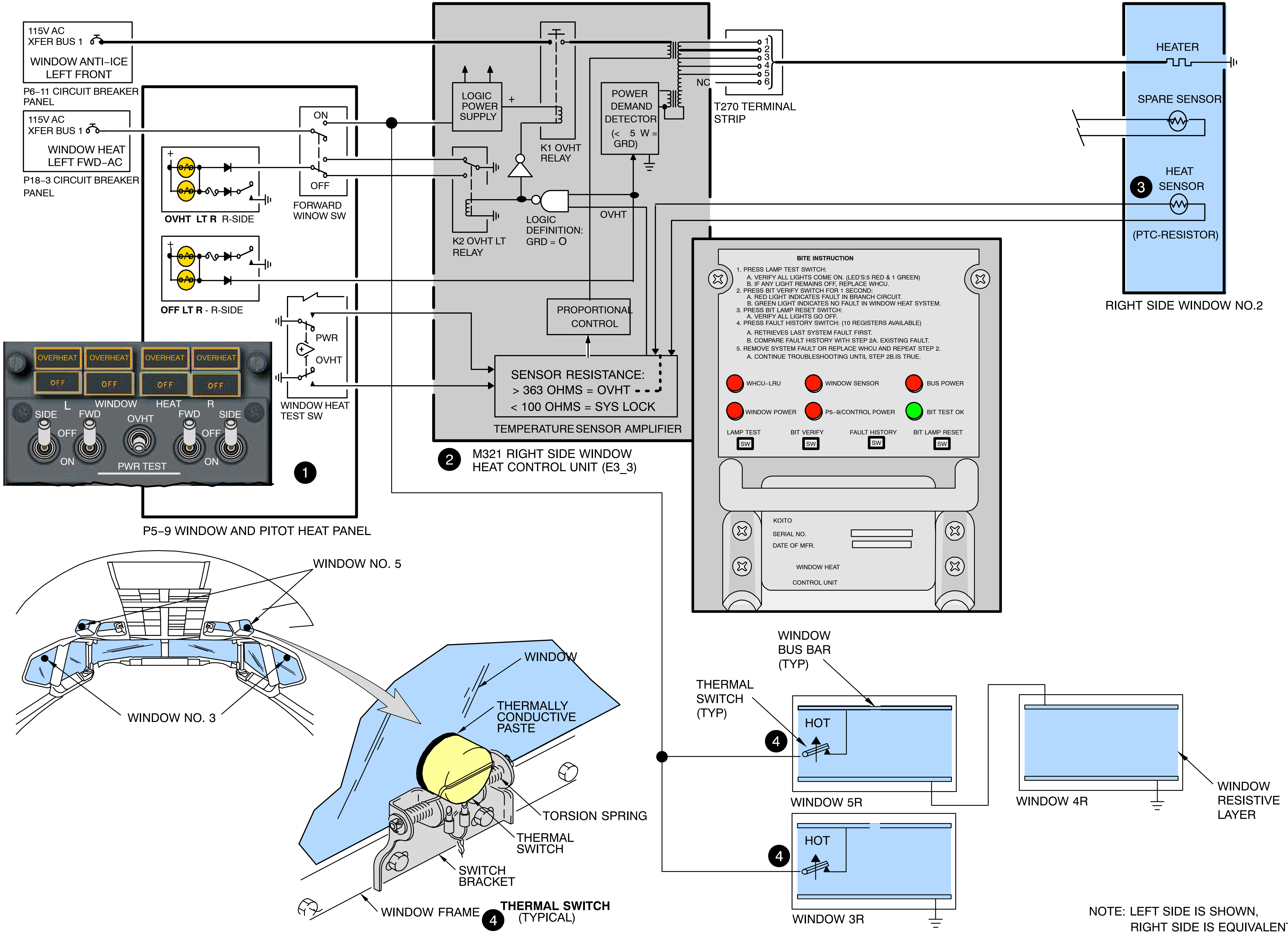


Figure 45 CWAI Logic Block Diagram

Reference to Figure 46 WHCU-Operation Schematic

30−41 CWAI SYSTEM

GENERAL

Each of the No.1 and No.2 window heat systems are operated by the actuation of the respective control switch in the ON position. Control power will be directed from the load control center to the Window Heat Control Unit for the respective window.
The No.1 and No.2 windows are maintained at 43° C by the Window Heat Control Unit.
When system is first energized, a Warm−Up Ramp function causes the control power to the electronic switch to increase gradually from zero to full power in approximately 3 minutes, unless it is controlled at a lesser level by the window, reaching control temperature before ramp time runs out.

1 Overheat Indications

Four amber OVERHEAT lights give the crew visual indication of overheat conditions for the No.1 and 2 windows.
When an overheat occurs, the WHCU removes and locks out power to the window until the window cools and the system is reset.
To reset an overheat condition, momentarily place the related WINDOW HEAT switch to the OFF position, then return the switch to the ON position.

2 Off Indications

Four amber OFF lights give the crew visual indication of the status of window heat to the No.1 and 2 windows. The lights go off when power is supplied to the related window.

3 Window and Pitot Heat Control Panel

The controls and indications for the control cabin window anti−icing system are on the P5−9 panel.

4 Window Heat Control Units

There are four identical WHCUs. Each WHCU controls the heat to one window.
The WHCUs get 28v dc and 115v ac for control and indication.
The window heat control units are in the EE compartment.
Two are on the E4−2 shelf and two are on the E2−1 shelf.

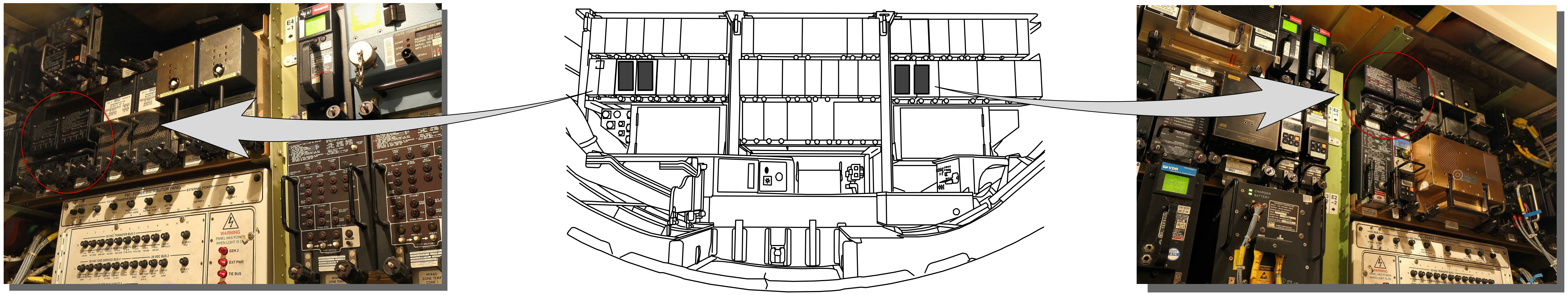
5 Window Temperature Sensor

There are two temperature sensors in each window, Primary sensor and Spare sensor.
If the primary sensor fails, you can switch to the spare sensor.

6 Windshield Sensor Switches

The windshield sensor switches are on the forward outboard E4 rack.

NOTE: On the ground, the MASTER CAUTION and ANTI−ICE annunciator lights are inhibited for the amber OFF light when left engine throttle is retarded.



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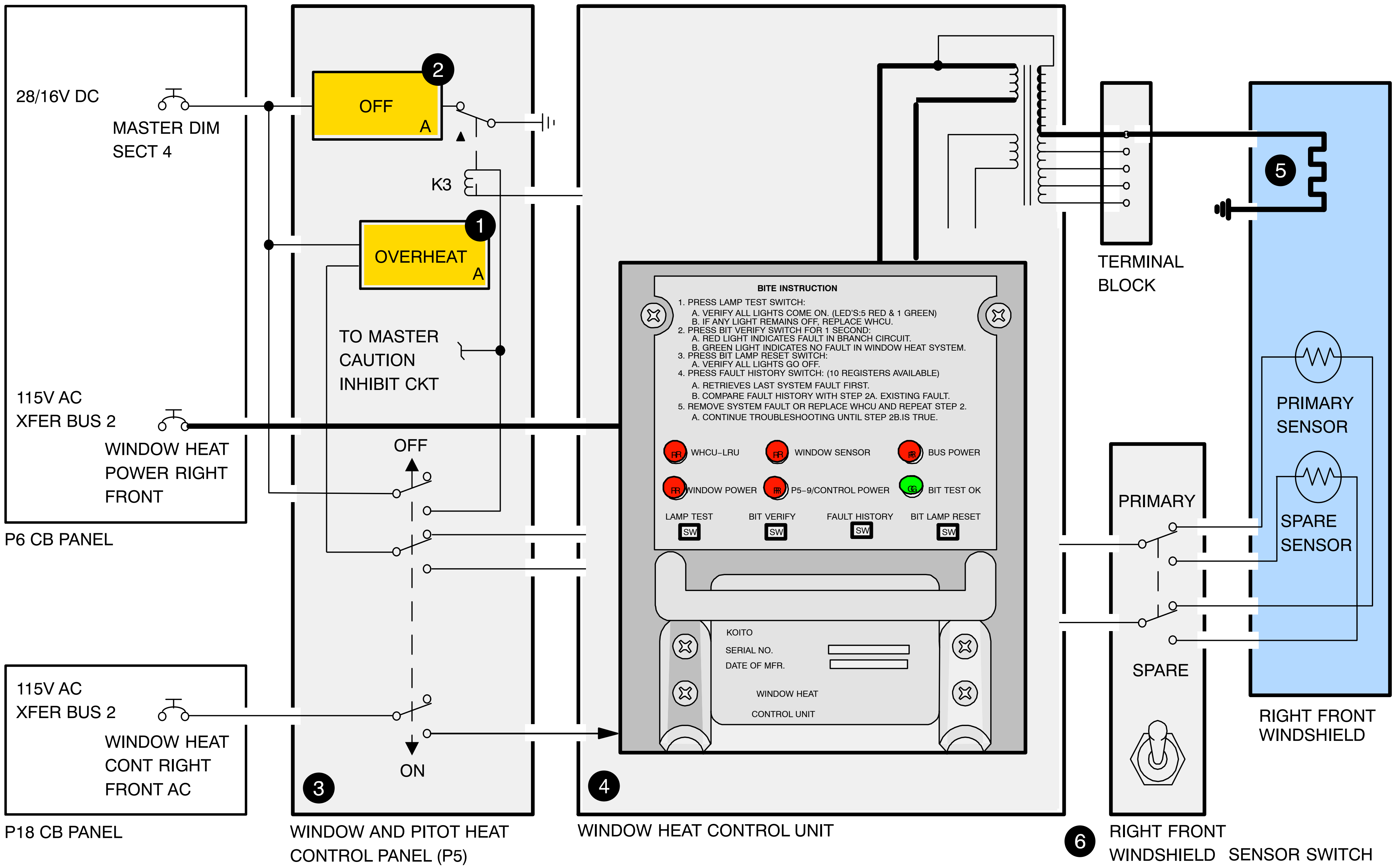


Figure 46 WHCU-Operation Schematic

Reference to Figure 47 Windshield Wiper/Water&Toilet Drain Anti-icing Overview

30-42 WINDSHIELD WIPER SYSTEM

GENERAL

Two WIPER control switches on the P5 forward overhead panel give the flight crew control of the system.
The system has two windshield wiper and drive assemblies. There are two windshield wiper selectors, one for each windshield wiper system.
Put the windshield wiper selector in one of the these positions to operate the system:

- INT

  Intermittent wiper operation, one sweep cycle approximately every 7 seconds
- LOW

  Low speed wiper operation, approximately 160 sweeps per minute
- HIGH

  High speed wiper operation, approximately 250 sweeps per minute.
- PARK

  Put the windshield wiper selector in the PARK position to stop wiper operation.

1 Windshield Wiper Switches

There are two windshield wiper selectors.
It is a voltage divider and sends different voltage signals to the motor electronic control package to provide intermittent, low, and high speed wiper operation.

2 Windshield Wiper Motor

The motor electronic control package controls the motor speed in response to the WIPER switch position signal.
A thermal switch in the motor assembly cuts out motor operation if the temperature in the motor gets to 266F (130C).
The thermal switch resets automatically when the motor cools.
The PARK position will cause both blades to rotate outboard to the lower window edge and stay there.

30-71 DRAIN ANTI-ICING WATER&TOILET DRAIN ANTI-ICING

GENERAL

It is important to prevent ice formation in the water and toilet systems.
Ice formations on the forward drain mast can break off and damage airplane structure.
The water and toilet drain anti-icing systems use electric power for heat.
These system components have integral heaters:

- Service panel fittings
- Drain masts
- Hoses with integral heating elements.

Components without integral heaters get heat from these components:

- Heater tape ("ribbon" heaters)
- Heater blankets

1 Potable Water Fill Fitting

Uses 28v ac power.

2 Potable Water Fill Hose

The hose heater element uses115v ac power.

3 Potable Water Supply Hoses

The hoses use 115v ac power.
Thermostatic switches (control and overheat) in the hoses control heat to the hoses.

4 Gray Water Drain Valve/Lines

The tape heaters use ll5v ac power.
An in-line thermostatic switch controls heat to the drain mast inlet line.

5 Drain Masts

115v ac in flight 28v ac on the ground.

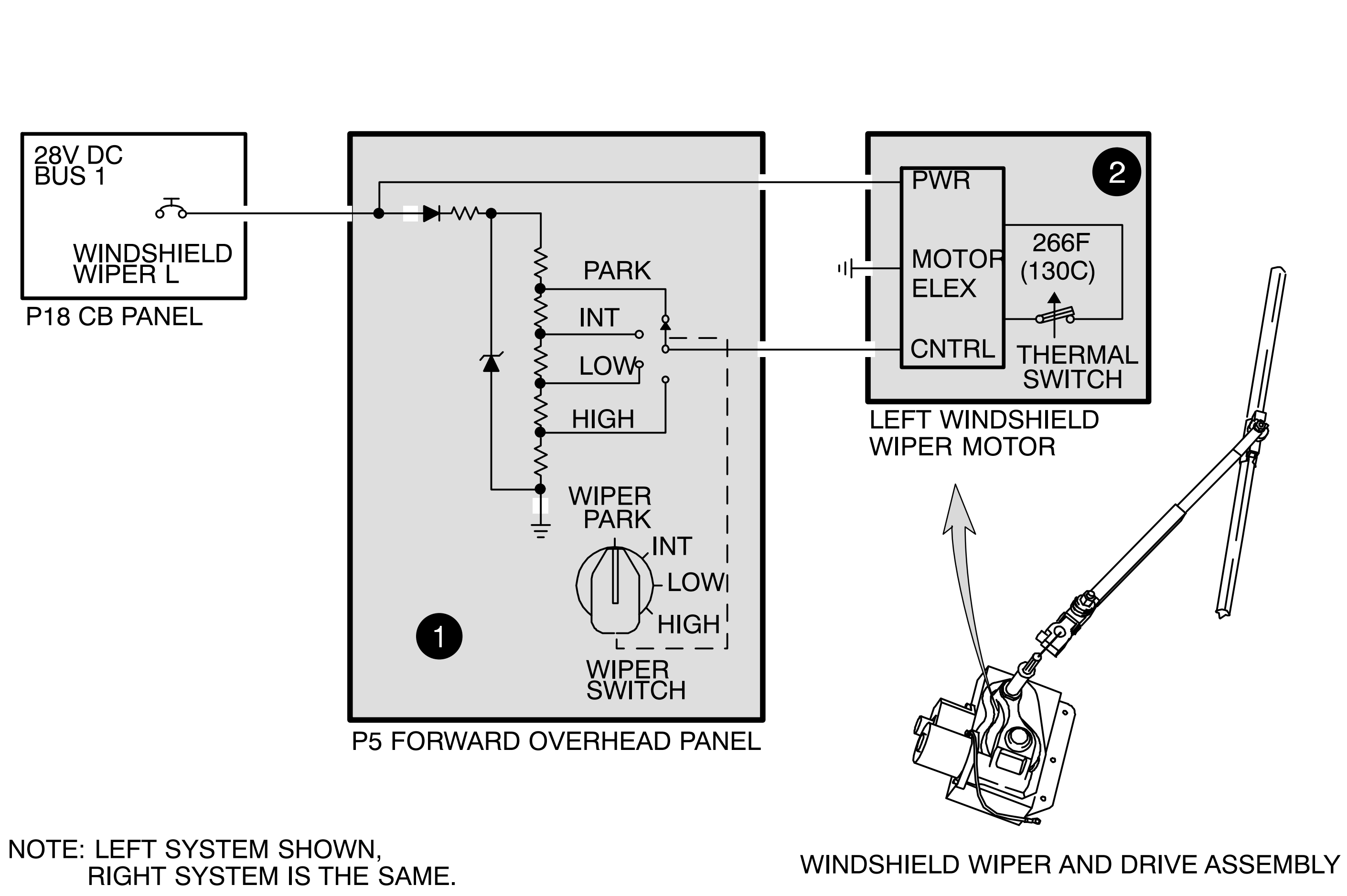
6 Waste Tank Drain (Ball) Valve

The blanket heater uses 115v ac power.

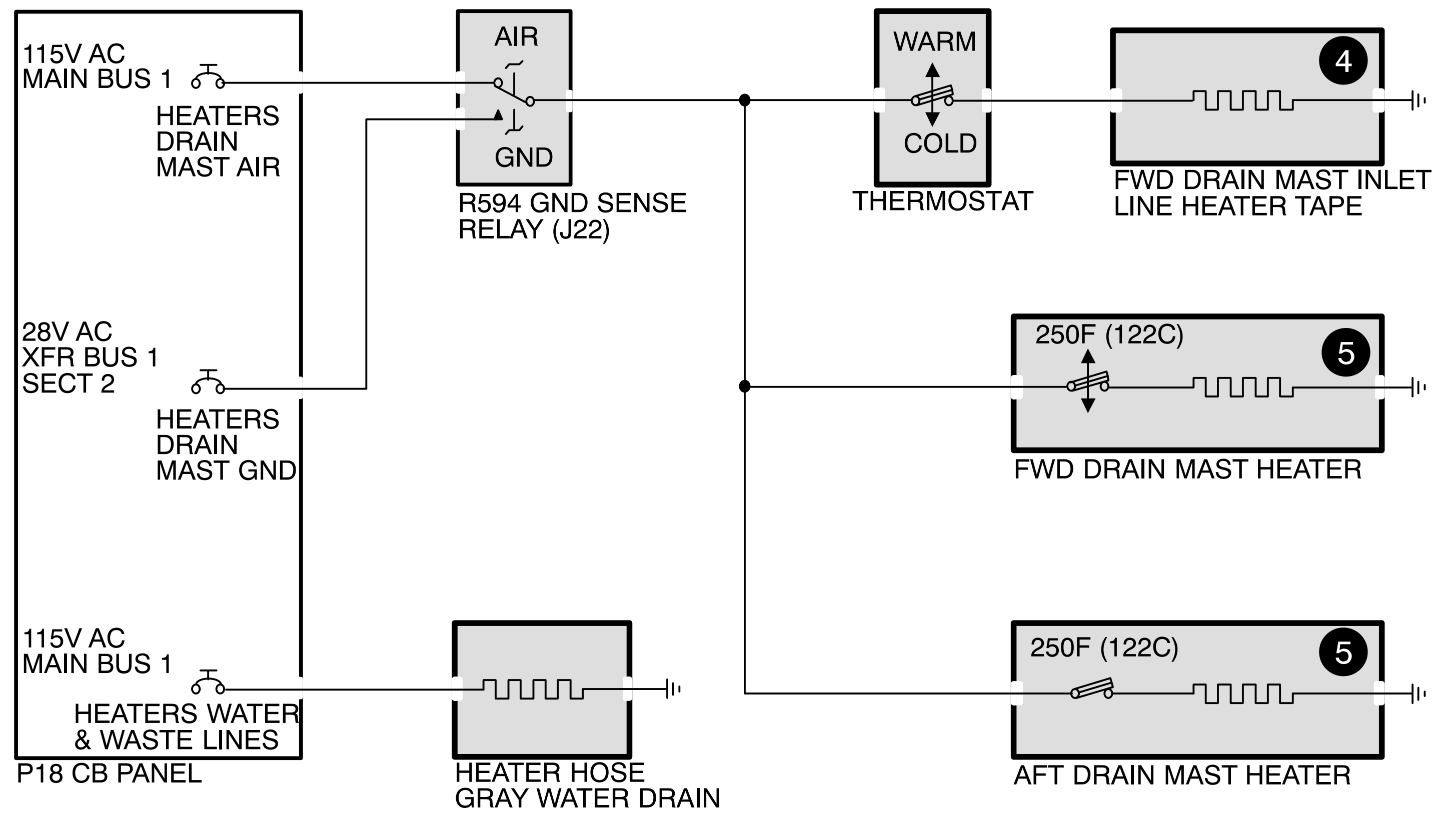
7 Waste Tank Rinse Line

The line heater uses 28v ac.

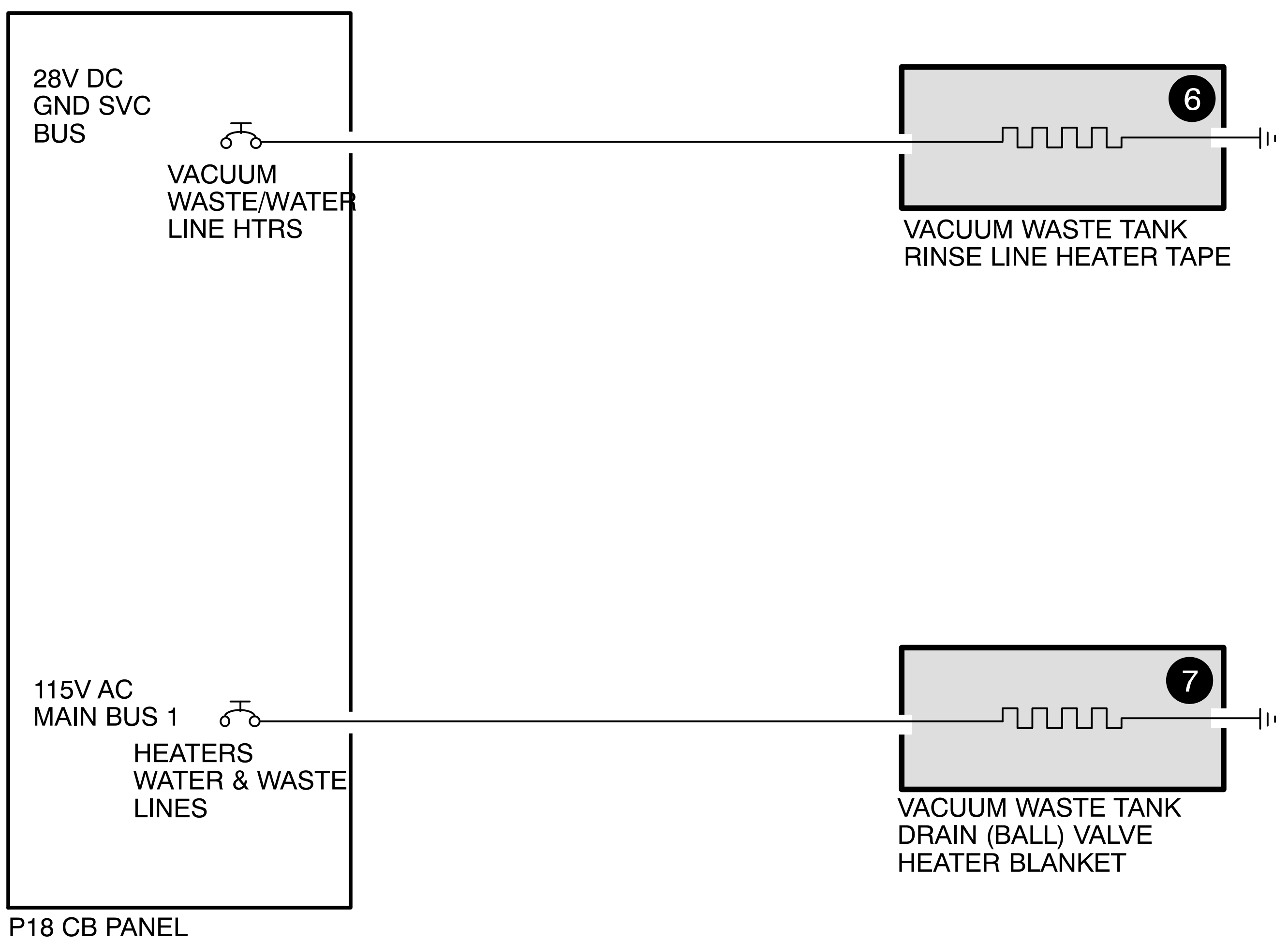
WINDSHIELD WIPER - FUNCTION DESCRIPTION



WATER AND TOILET DRAIN ANTI-ICING - GRAY WATER AI



WATER AND TOILET DRAIN ANT-ICING - VACUUM WASTE AI



WATER AND TOILET DRAIN ANT-ICING - PORTABLE WATER AI

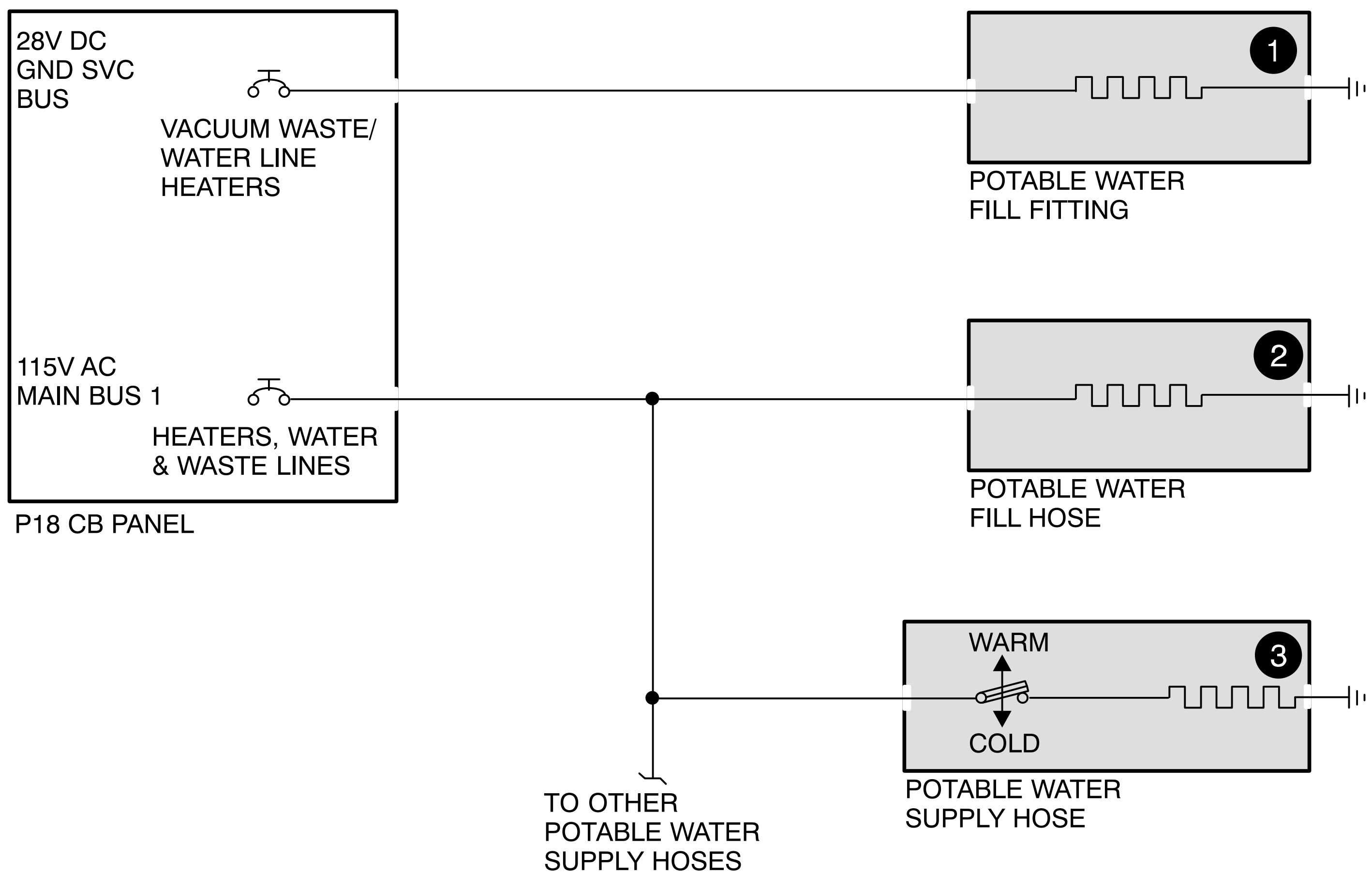


Figure 47 Windshield Wiper/Water&Toilet Drain Anti-icing Overview

Reference to Figure 48 Wing Thermal Anti Ice System Schematic

ATA 30 ICE AND RAIN PROTECTION

30-11 WTAI

SYSTEM DESCRIPTION

1 Wing Anti Ice Switch

The wing anti-ice valve is open when the wing ant-ice switch is in the ON position. The blue VALVE OPEN light monitors the valve and switch positions.

2 Wing Anti Ice Valves

The wing thermal anti-ice shutoff valves control air flow from the pneumatic manifold to the anti-ice supply ducts.

The wing thermal anti-ice (WTAI) system uses 115v ac power to operate the WTAI shutoff valves

3 WTAI Supply Manifold

The supply manifold supply hot air to the telescoping ducts.

4 WTAI Telescoping Duct

The wing anti-icing telescoping ducts supply hot air to the spray tubes in the wing leading edge.

5 Slat Spray Duct

The heated air flows to the three inboard leading edge slat spray tubes. The air sprays into the slat cavities and exhausts overboard through holes in the bottom of the slats.

6 WTAI OVHT Switch (125°C)

- The wing anti-icing ground overheat thermal switch protects the wing leading edges from overheat damage.
- This protection operates only when the wing thermal anti-ice (WTAI) system is on and the airplane is on the ground.

7 WTAI Solenoid Valve

The wing thermal anti-ice (WTAI) solenoid valve bleeds actuator pressure from the precooler control valve. The WTAI solenoid valve operates when the wing thermal anti-icing system is used on the ground.

The wide open precooler control valve gives maximum cooling to the engine bleed air. This protects the wing leading edges from overheat damage.

8 Throttle Switche (>60°)

The two control stand WTAI switches give thrust lever position feedback to the engine and wing anti-ice control panel (P5-11).

The wing anti-ice control panel closes both WTAI shutoff valves in response to either control stand wing anti-ice switch. The control stand enables this protection only when the airplane is on the ground. This conserves engine power for takeoff.

9 PSEU

The air/ground logic gives the wing anti-ice system air ground sense feedback.

10 Engine & WTAI Module

The anti-ice panel does these things:

- Gives the flight crew interface with the wing and engine inlet cowl anti-icing systems.
- Has the circuitry for control and indication of the wing anti-icing system.
  These are the light indications:
  - Light is off - the switch is in the OFF position and the valve is closed.
  - Light is dim - the switch is in the ON position and the valve is open.
  - Light is bright - the switch position and valve position disagree or the valve is in transit.

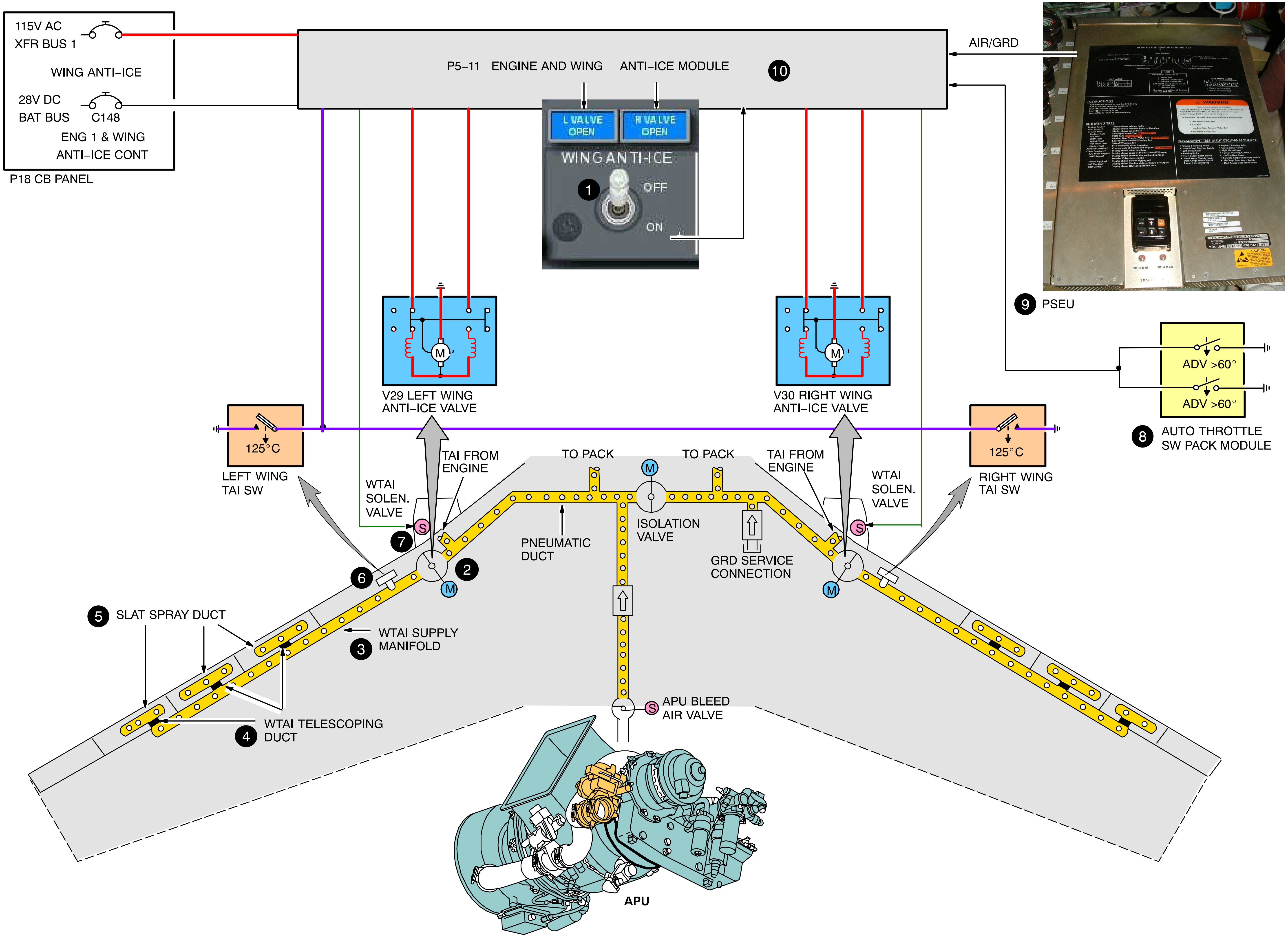


Figure 48 Wing Thermal Anti Ice System Schematic

General

The FDRS receives and stores about 1275 B737 NG airplane parameters from airplane systems and sensors. It keeps this data and protects it if the airplane has an accident. Each airline may request additional parameters to be recorded for customized purposes like ACMS Trendmonitoring!

The FDRS has these components:

- FDR (Flight Data Recorder)
- FDAU (Flight Data Acquisition Unit)
- FDAU status relay
- Flight recorder test module
- Printer
- System test plug/connector
- Program switch module.

1 FDAU

The FDAU collects mandatory and recommended flight data for the flight data recorder. It also collects aircraft condition monitoring system (ACMS) data for airline use. The FDAU changes the mandatory and the recommended flight parameters into the Harvard biphase format. This data goes to the flight data recorder. It has ACMS software in its memory.
This software selects input data to monitor. The data is changed to a digital format. The FDAU keeps it in memory. Data can go to the data loader control panel and then move to a disk in a data loader.

2 FDR

The FDR gets formatted data from the FDAU and keeps it in solid state non-volatile memory. It has the capacity to keep the last 25 hours of flight data. The FDR records the data in a fire and crash resistant LRU. An underwater locator beacon is on the front of the FDR.

3 Flight Recorder/Mach Airspeed Warning Test Module

The flight recorder test module shows the condition of the flight recorder system. If there is a system fault, an amber OFF light comes on. The OFF light also comes on if the system is off. The flight recorder test module also has a TEST/NORMAL switch. When this switch is in the TEST position, the FDR gets power.

4 Engine Running/Ground Sensing Relays

The FDRS operates automatically when one of the engines is in operation and provides Oilpressure or the Airplane is in the Air.

5 FDAU Status Relay

The FDAU status relay controls the flight recorder light. Normally, the FDAU BITE out signal causes the FDAU status relay to energize. This removes the ground from the flight recorder light and it goes out.
If the FDAU detects a fault, the BITE out signal removes the ground from the FDAU status relay.
A ground connects to the flight recorder light and the flight recorder light comes on.

6 System Test Plug/Connector

Connect ground support equipment to the system test plug to test the FDRS.

7 Program Switch Module

Gives the FDAU informations about the:

- A/C Type
- Tailsign
- Fleet

8 Data Loader Control Panel

ACMS data from the FDAU goes through the data loader control panel to a data loader. The data loader can store data from the FDAU on a disk. The data loader control panel switch lets you select the transfer of ACMS data. You can transfer software from a disk in the data loader to the FDAU through the data loader control panel.
Note: not seen on the schematic

9 Printer

A printer gives printed ACMS reports. The FDAU sends report data to the printer. The printer sends status and bus control signals to the FDAU.
Note: not seen on the schematic

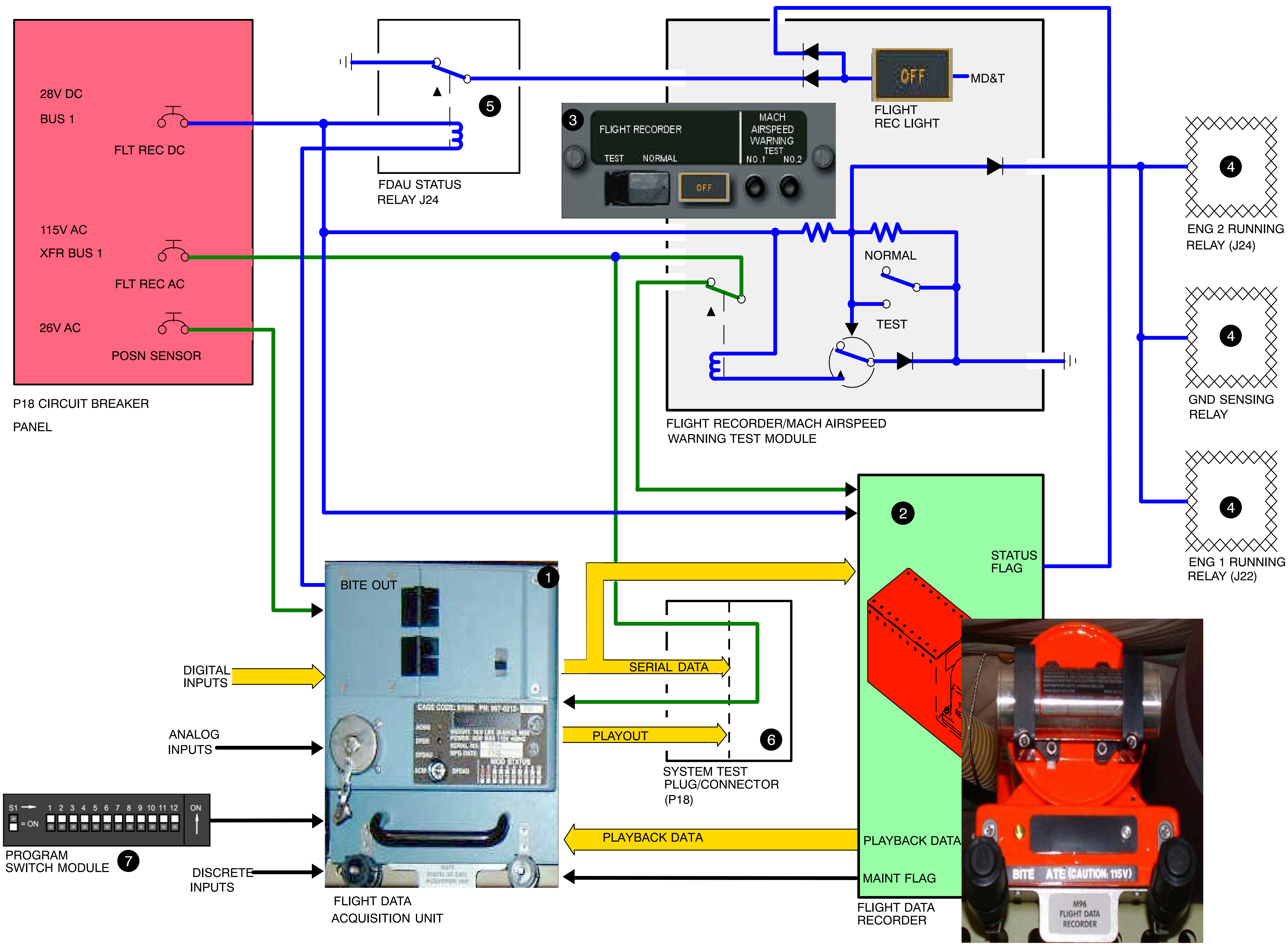


Figure 49 FigureText

Reference to Figure 50 ACMS - Entry of ACMS Screens

ATA 31 INDICATING&RECORDING SYSTEM

31-31 AIRCRAFT CONDITION MONITORING

GENERAL

With the Aircraft Condition Monitoring Systen (ACMS) there are many functions available, but only some for maintenance purposes.
For maintenance purposes the following functions are available with the ACMS system:

- ARINC 429 Label Callup
- ACMS Alpha Call-up
- Recording
- Readout
- Printout.

The FDAMS (**F**light **D**ata **A**cquisition and **M**onitoring **S**ystem) Unit consists of both an ARINC 717 DFDAU function and the ACMS.
The purpose of this interface is to pass to the ACMS the same data that is being output to the Flight Data Recorder. This provides the ACMS with the ability to record the Mandatory Flight Data Recorder information, i.e., QAR (**Q**uick **A**ccess **R**ecorder).
This information can only be recorded to the PCMCIA Card. The following Options are enabled in this ACMS Database:

- **Option 1**
  Reconfigurable ACMS Recorders (SAR and DAR)
- **Option 2**
  Remote Programming via Datalink
- **Option 3**
  Flight Operations Quality Assurance Report
- **Option 4**
  Pre-Programmed ACMS Maintenance Reports

1 FDRS-PRINTER

The printer gives a paper copy of reports.
The printer has 12 data inputs and one status/control output ARINC 429 data bus.
The printer uses white thermal sensitive paper.

These are the printer switches:

- SLEW switch, moves the paper,
- RESET switch, turns off the message light and
- TEST switch, starts the built in test.

These are the printer indicators:

- MSG light,comes on when you get a report,
- PAPER light, comes on when there is no paper in the printer,
- FAIL light, comes on if the test sequence finds a failure and
- PAPER FULL-EMPTY indicator, shows the quantity of paper remaining in the printer.

2 IFE / PASS SEAT SWITCH

With this switch in position ”off”, the electrical power for the printer is removed!

3 MCDU

The MCDUs are used to access systems like the aircraft conditioning system ACMS.

4 ALPHA CALL UP

To show parameter:

1. Choose alpha parameter
2. Type in scratch pad
3. press line select key where you want to see the selected parameter.

5 5 LABEL CALL UP

To show parameter:

1. Select label-port list
2. Note the parameter of the port you want to see the parameter
3. Enter parameter number.

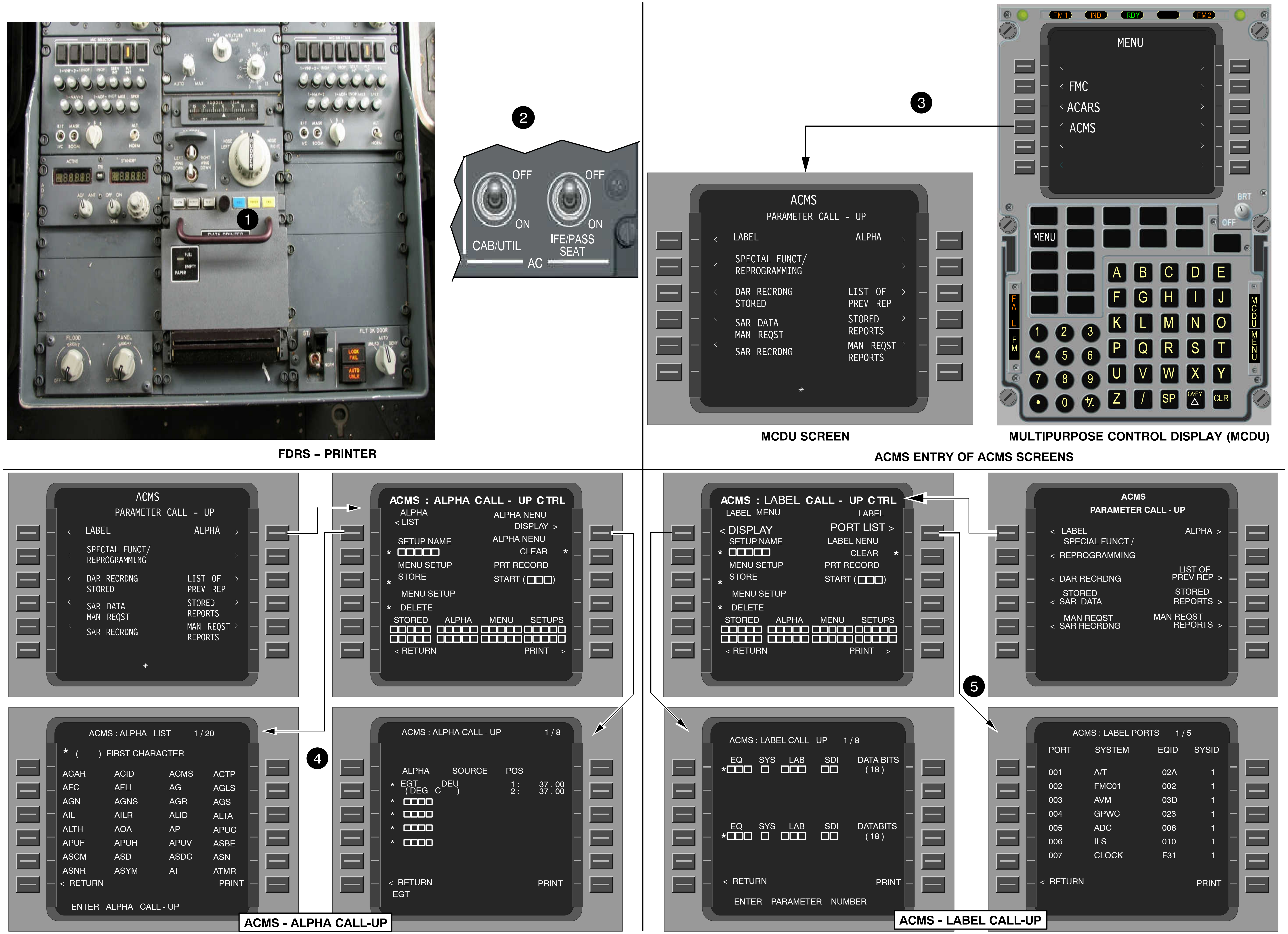


Figure 50 ACMS - Entry of ACMS Screens

Reference to Figure 51 Aural&Master Caution - Operation

31−50 AURAL WARNING SYSTEM

AURAL WARNING SYSTEM

GENERAL

The aural warning module has two parallel channels, channel A and channel B.
Both channels receive inputs from the airplane systems. Both channels operate at the same time.
If one channel fails, the flight crew will hear a 6db decrease in volume from the aural warning module.
There is a built−in test equipment (BITE) switch on the aural warning module. Each channel receives a signal from the BITE switch.
The aural warning module receives 28v dc from four circuit breakers. Each circuit breaker supplies power for different audio sounds.

1 INPUT CIRCUIT

Each channel has two input circuits. One circuit receives discrete ground Inputs.

2 CONTROLLER

The controller receives signals from both input circuits and causes the aural synthesizer to make sounds. It controls the sequence of some sounds made by the synthesizer. Intermittent horn, Steady horn, Wailer.
The bell, the clacker, and the chime sounds do not have a sequence.

3 ANALOG AMPLIFIER

The analog amplifier adds the signals from both synthesizers.

4 SPEAKER

The speakers provide the sound.

5 BITE SWITCH

The BITE switch lets the operator do a test of each channel of the aural warning module.

MASTER CAUTION SYSTEM

GENERAL

The purpose of the master caution system is to inform the flight crew that system warnlights, located behind pilots or out of view of the captain and copilot, are illuminated.
Example:

With a hydraulic low−pressure light illuminated, (which is located on the aft overhead panel and therefor out of view of the pilots), on the glareshield the system annunciator HYDR and both MASTER CAUTION lights will illuminate.

1 RESET OF MASTER CAUTION LIGHTS

Press captains or copilots master caution light. Master caution lights and master caution system annunciator lights will extinguish.

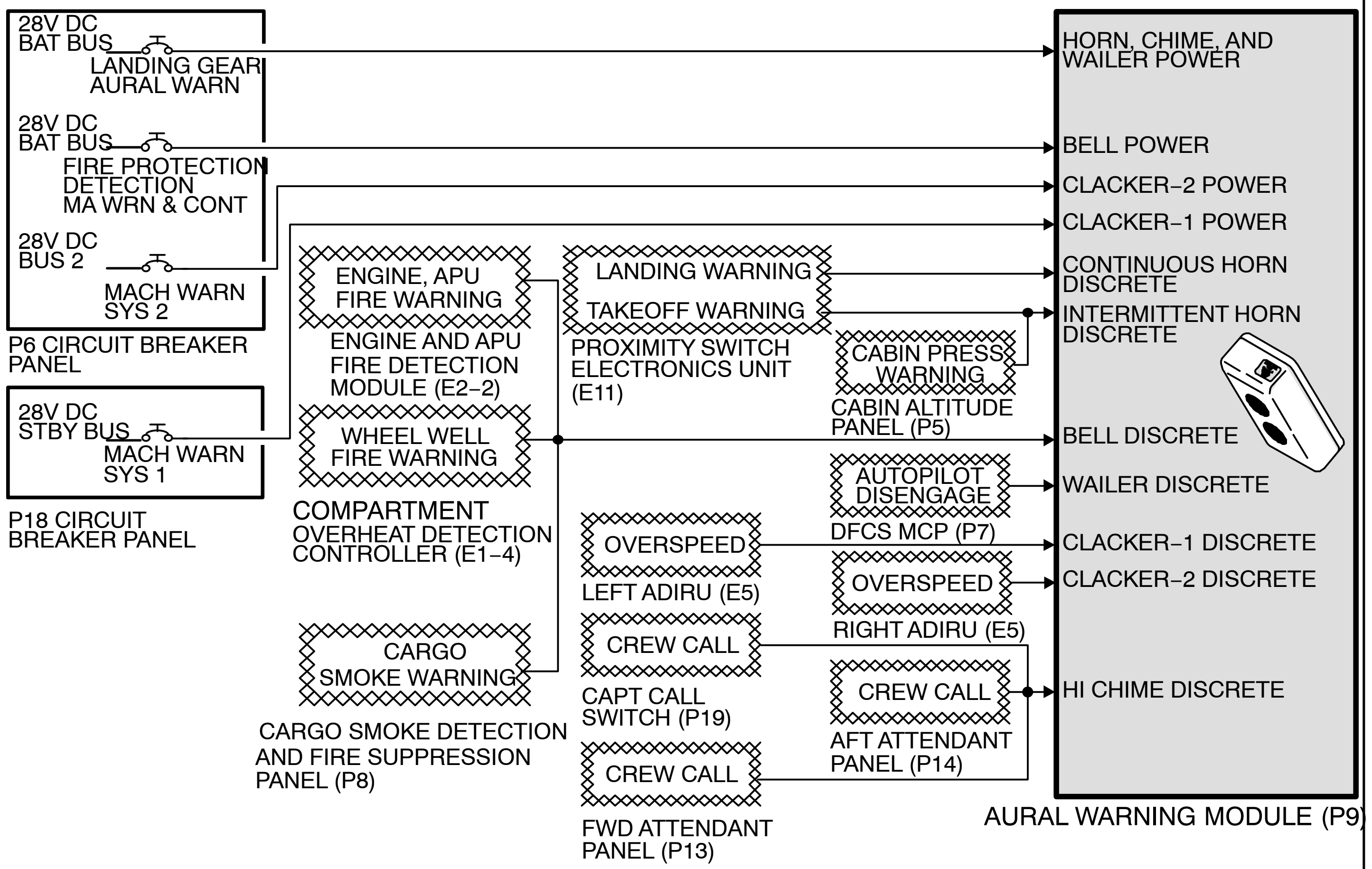
2 RECALL OF THE MASTER CAUTION LIGHTS

Press any master caution six−pack.
Six pack lights whose system warn light is still on will illuminate again.

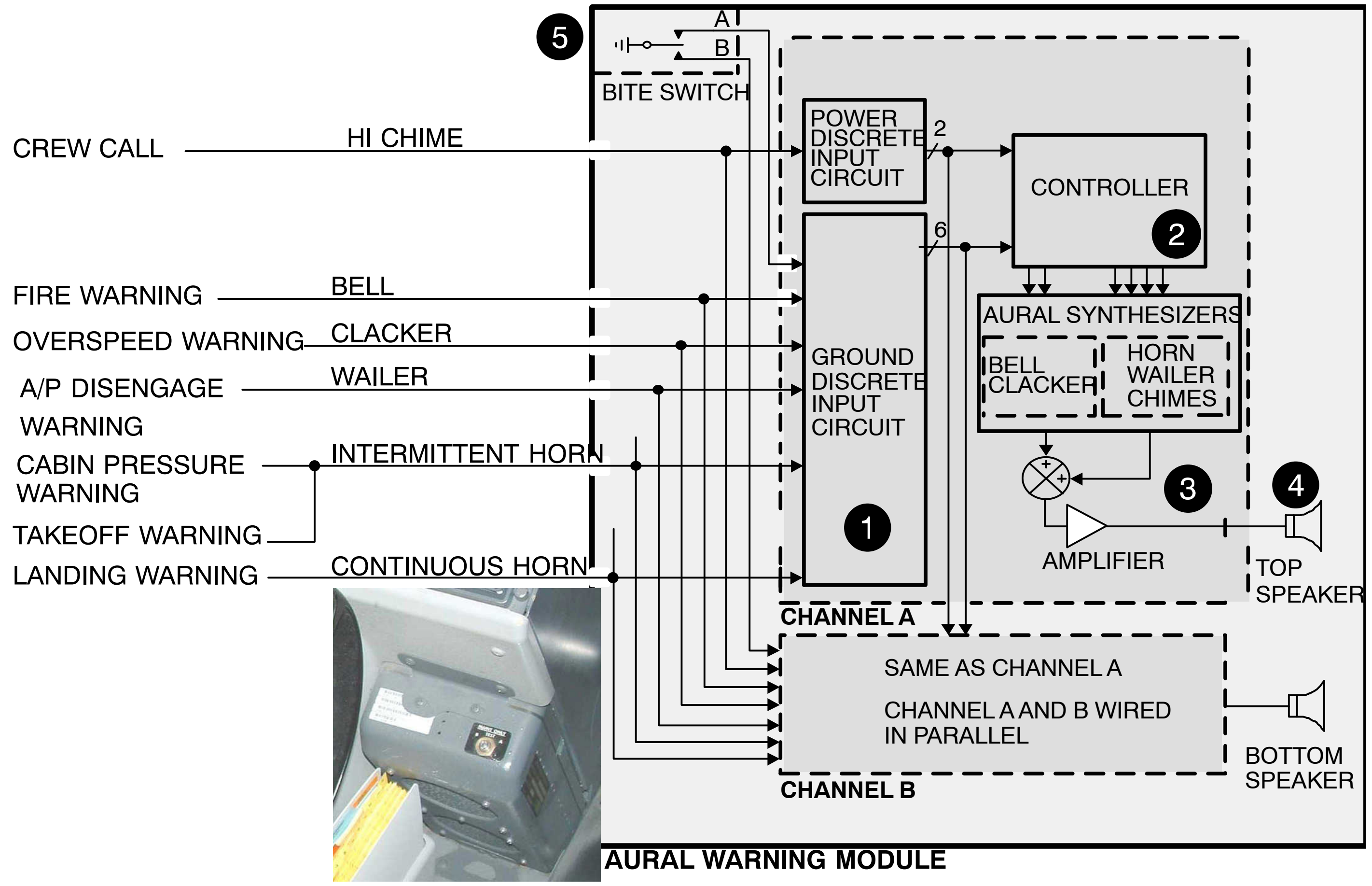
3 FUEL PANEL (typical Example)

The hydraulic panel causes both MASTER CAUTION lights and the HYD light on the right system annunciator lights to come on when one or more of these hydraulic system lights come on:

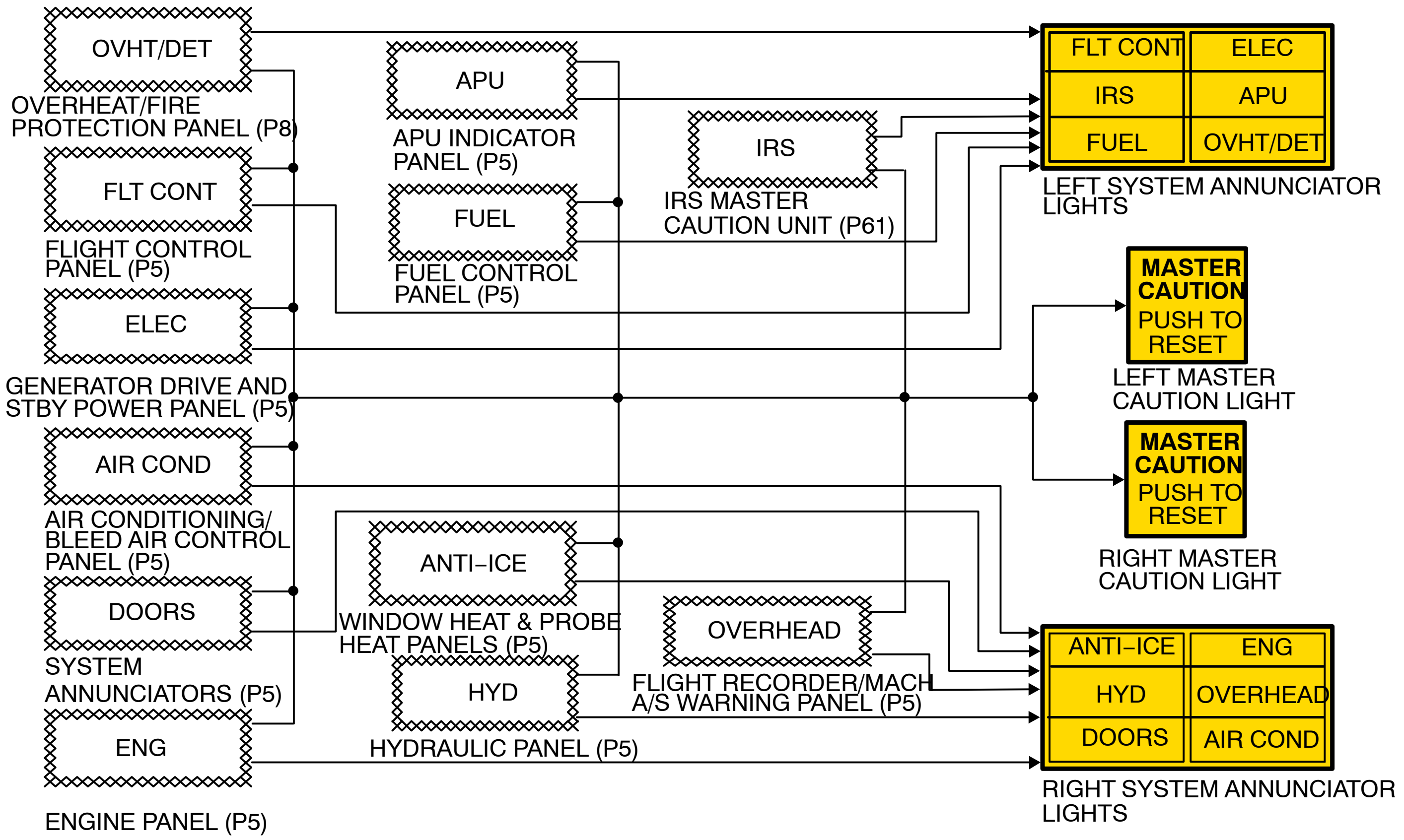
- System A Elec 2 Low Press
- System A Elec 2 Overheat
- System A Eng 1 Low Press
- System B Elec 1 Low Press
- System B Elec 1 Overheat
- System B Eng 2 Low Press.



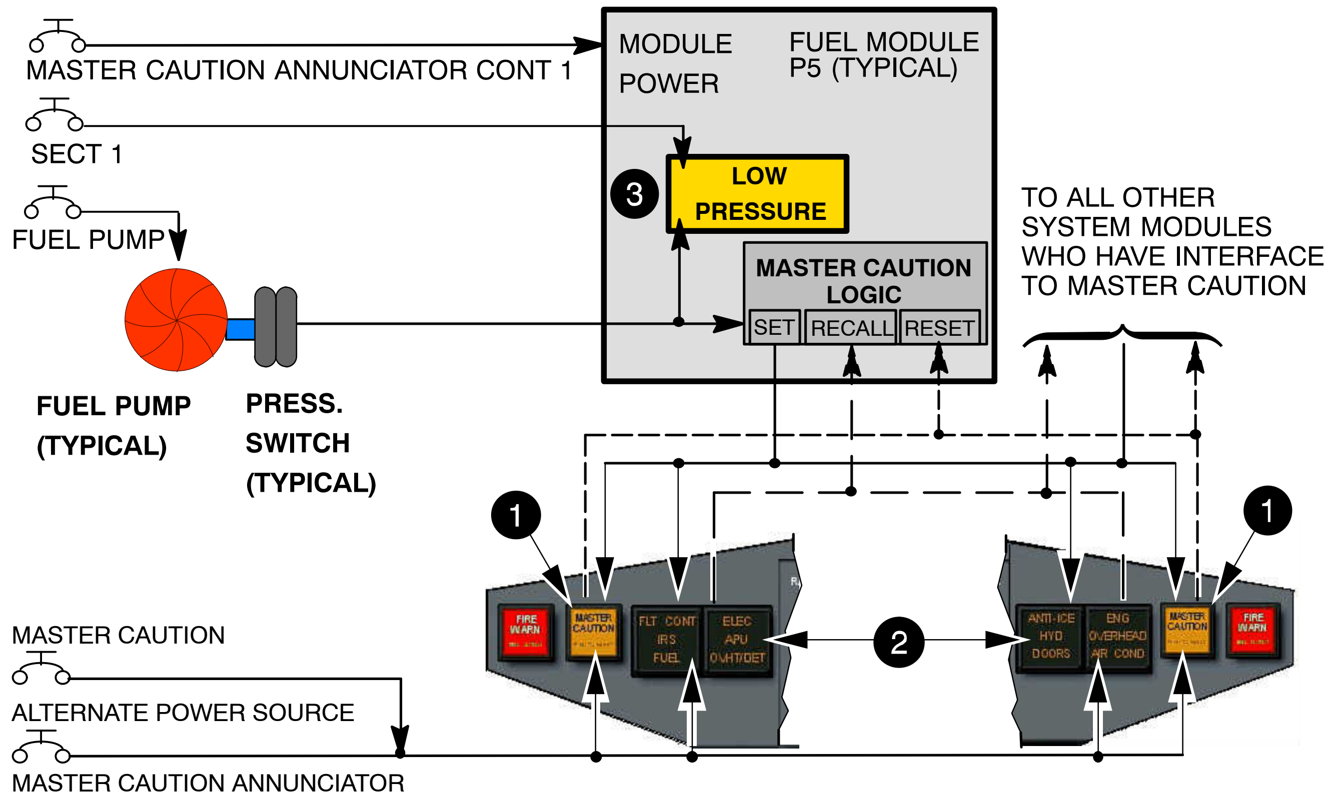
GENERAL AURAL WARNING-PWR INTERFACES



AURAL WARNING-FUNCTIONAL DESCRIPTION



GENERAL MASTER CAUTION-INTERFACES



MASTER CAUTION - INTRODUCTION

Reference to Figure 52 Common Display System- Schematic

31-62 COMMON DISPLAY SYSTEM

GENERAL

The CDS (**C**ommon **D**isplay **S**ystem) shows performance, navigation and engine information in many different formats on six display units in the flight compartment.

1 DEU (DISPLAY ELECTRONICS UNIT)

The common display system has two DEUs (**D**isplay **E**lectronics **U**nits).
The DEUs do these functions:

- Collect data from airplane systems
- Change the data to a video signal to show on the display units
- Send data to other airplane systems

The DEU monitors the presence, status, and validity of inputs and cross compares inputs with the other DEU.
A coax coupler splits the video signal and sends the data to all six display units.
Both DEUs send data to all six display units.
The DEUs also are the interface between some avionic and airframe systems.
For example, the DEUs receive BITE data from the EEC (**E**lectronic **E**ngine **C**ontroller) and APU (**A**uxiliary **P**ower **U**nit). The DEUs send this data to the flight management computer and also send EEC data to other avionic systems.

2 CROSS CHANNEL BUSSES

Each DEU sends data on two cross channel busses to the other DEU.
The two output busses have different information.
The DEUs compare critical input signals that are received by both DEUs on the same ARINC 429 input bus. The onside values are compared with the offside values.
If the critical comparison data is not the same, CDS shows CDS FAULT on the PFD displays.
This is the critical comparison data:

- Engine fan speed (N1)
- Engine core speed (N2)
- Engine EGT (**E**xhaust **G**as **T**emperature)
- FMC bus 08 data
- FMC bus 09 data.

3 INPUTS

The computer for the CDS is the DEU. Many avionic and airframe systems interface with the DEUs.
These systems send ARINC 429, analog, and discrete data to the DEUs. The DEUs send ARINC 429, analog, and discrete data to these systems.

4 DISPLAY UNITS

The common display system uses six identical LCD units.
The DUs (**D**isplay **U**nits) show this type of information:

- Primary flight information
- Navigation information
- Engine information

There is a BLS (**B**ezel **L**ight **S**ensor) at the bottom edge of the face plate.

Each DU has internal temperature detectors. When the internal temperature reaches 110 C, the power supply shuts down the display unit. When the DU cools, the display unit comes on again.
The left outboard, left inboard, and upper center display units use blow through cooling. The right outboard, right inboard, and lower center display unit use draw through cooling. The lower center DU handle is at the top.

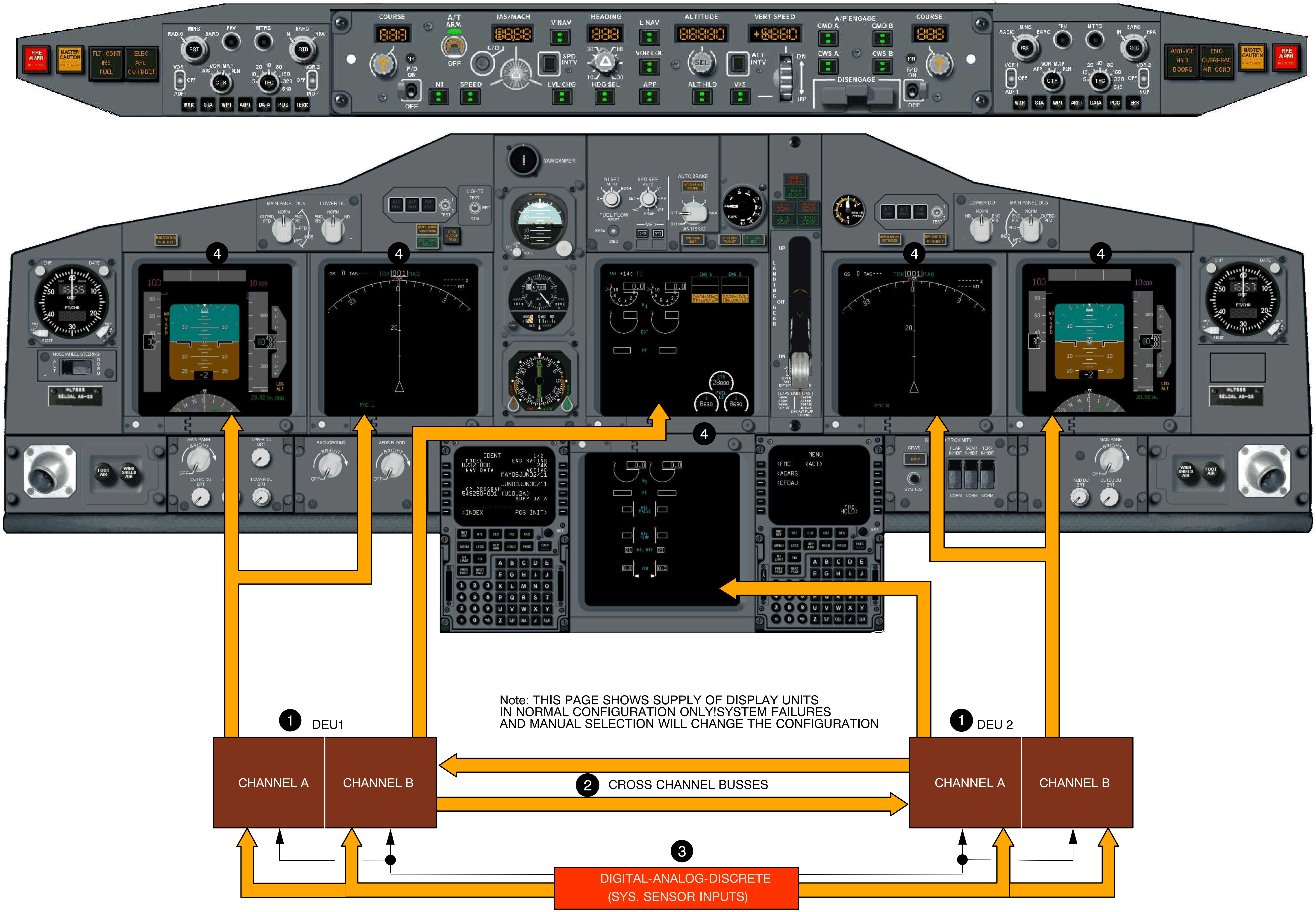


Figure 52 Common Display System- Schematic

Reference to Figure 53 CDS- GENERAL DESCRIPTION

1 POWER

The 28v dc standby bus supplies power to the CPT's components, Left DU's, Upper DU, EFIS control panel and DEU 1.

The 28v dc bus 2 supplies power to the FO's components, Right DU's, lower DU, EFIS control panel and DEU 2.

The 28v dc hot battery bus also supplies power to the DEU 1 and DEU 2.

This power is called the hold up voltage. The DEU uses the hold up voltage to maintain operation during power transients.

After a shut down, it will take 90 seconds to start the DEU operation.

The DEU also uses the hold up voltage to shut down the DEU processor.

COMPONENTS

These are the components of the common display system:

2 Two display select panels

3 An engine display control panel

4 Two EFIS control panels

5 One display source selector

6 Two display electronics units (DEUs)

7 Four coax couplers

8 Six identical display units (DUs)

9 Two brightness control panels

10 Two remote light sensors (RLSs).

11 PROGRAM PINS INTERFACE

The DEU (**D**isplay **E**lectronics **U**nits) and the DU **D**isplay **U**nits) have hardware program pins to identify DEU/DU position, DEU Airframe type and the parity of the Arinc 429 Datawords.

CDS MAINTENANCE MESSAGES

These are the CDS messages that can show on PFD.

1 INSTR SWITCH

Is shown on both PFDs for same source for inertial reference data (IRS XFR)

2 DSPLY SOURCE (≧ 50 %)

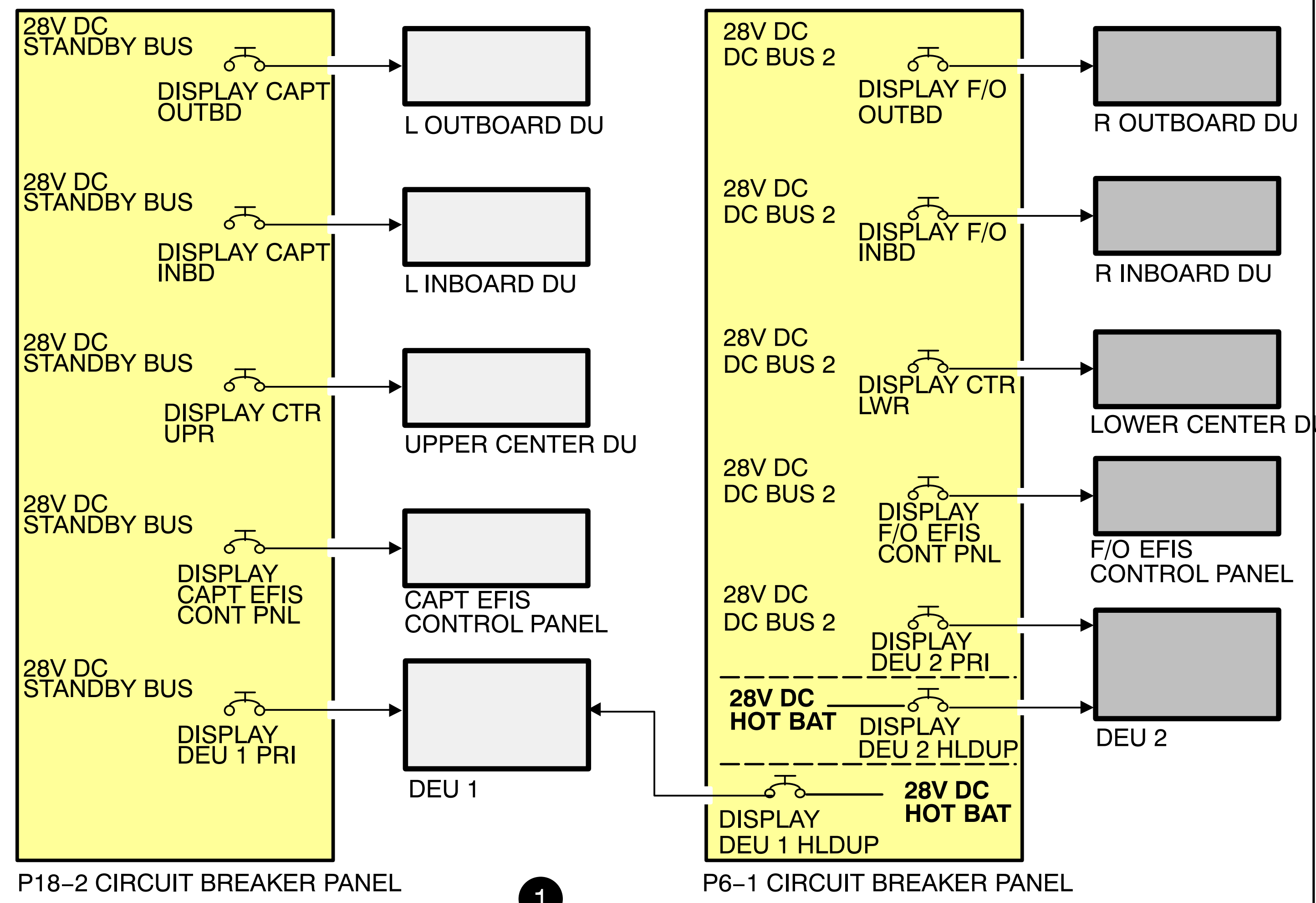
The message DSPLY SOURCE shows when all the display units get data from one DEU caused by a failure (with both Engines on) or when the display source selector is in the ALL ON 1 or the ALL ON 2 position. This Message caused by Faults in the Air will change to the Message CDS Fault after Engine shutdown.

3 CDS MAINT (< 50 %)

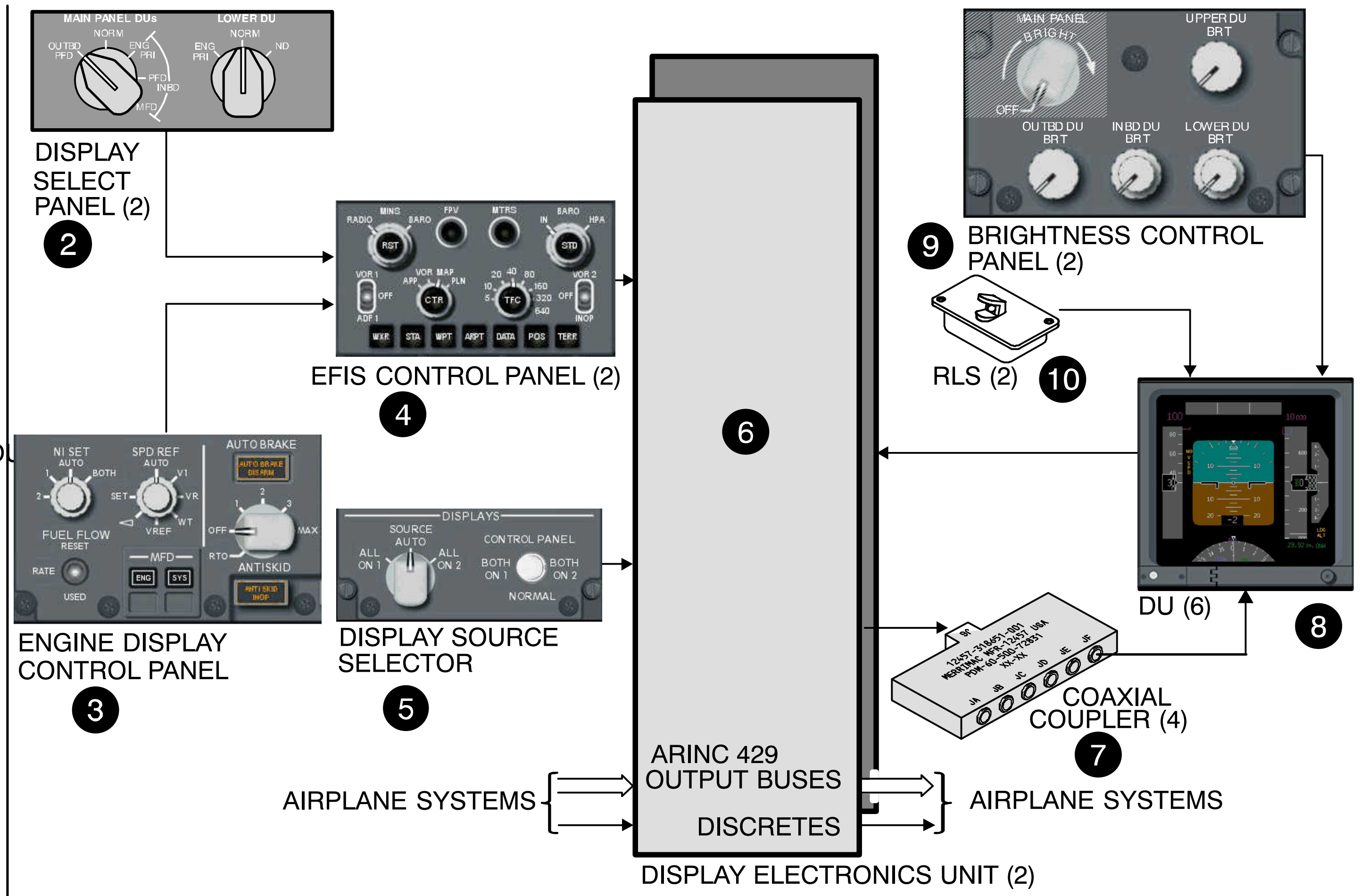
The message CDS MAINT shows only when the airplane is on the ground and at least one engine is off.

4 CDS FAULT (≧ 50 %)

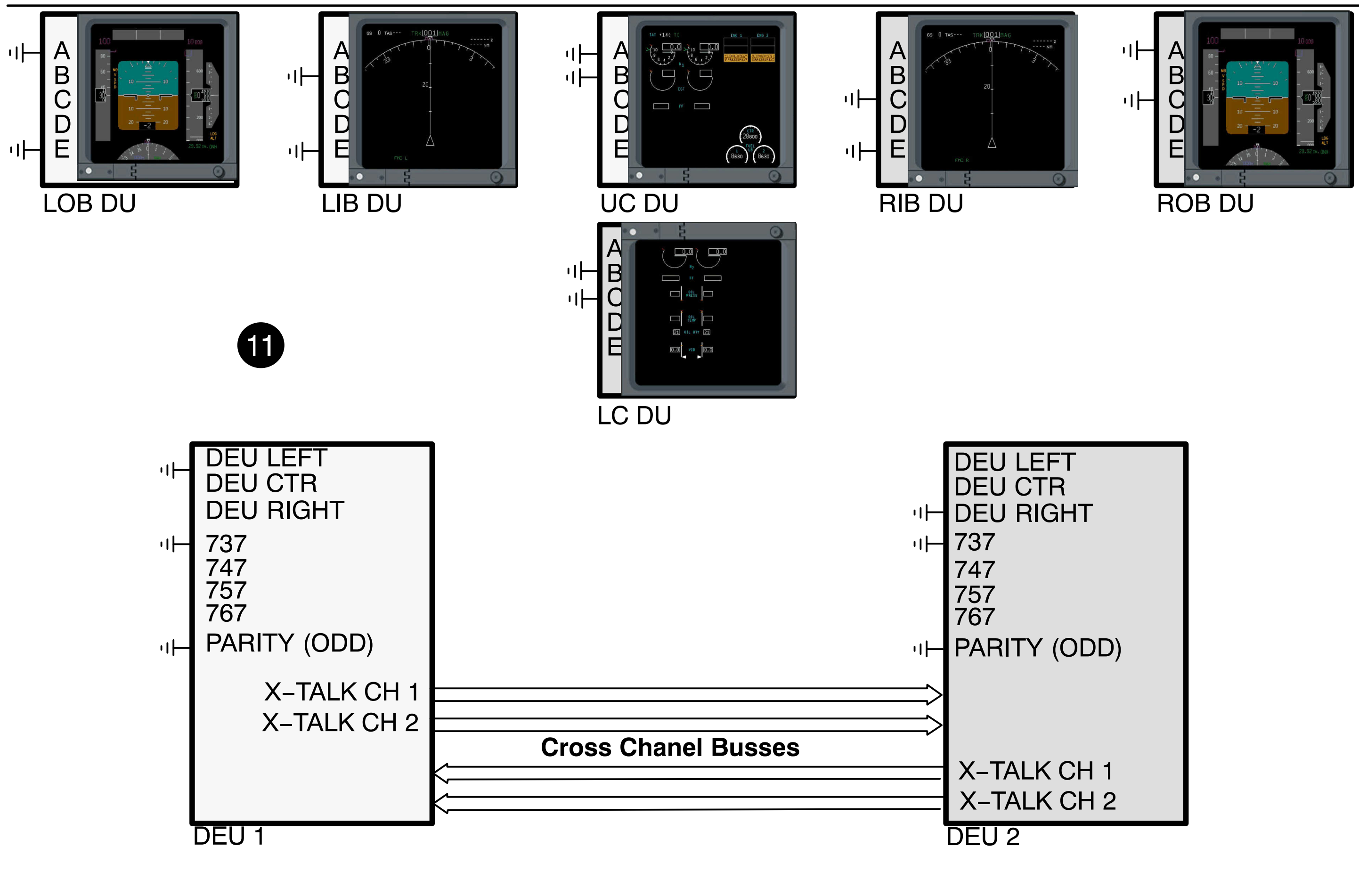
The CDS FAULT message shows only when the airplane is on the ground and at least one engine is off. The message CDS FAULT shows when there is a total DEU failure or if two or more circuit cards fail in a DEU. The message CDS FAULT shows if there is a miscompare of the N1, N2 or EGT data between DEU 1 and DEU 2.



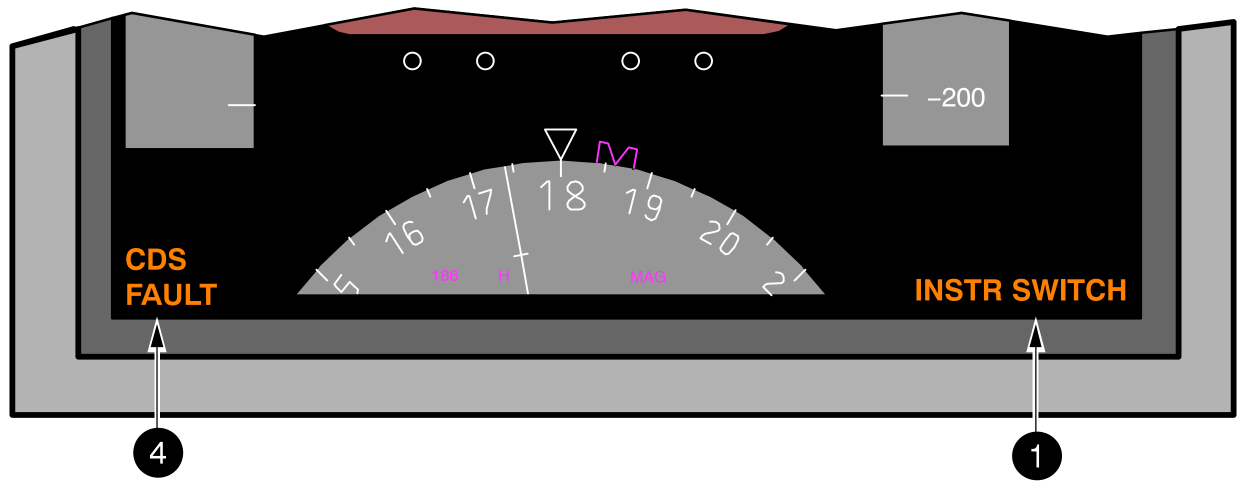
CDS - POWER INTERFACES



COMMON DISPL. SYSTEM - GENERAL DESCRIPTION



CDS-PRGM PINS/X-CHANNEL INTERFACE



1 INSTR SWITCH	INERTIAL REFERENCE DATA FROM SAME SOURCE (IRS XFR)
3 CDS MAINT	PARTIAL DEU FAILURE (LESS THAN 50% OF SIGNAL GENERATION CAPABILITY ID DEFECT)
4 CDS FAULT	DEU FAILURE OR BOTH DEU(S) HAVE A PARTIAL FAILURE OR INCOMPATIBLE S/W OR H/W OR MISCOMPARE OF CRITICAL DATA OR HOT BATTERY BUS NOT AVAILABLE OR DATA LOAD SWITCH IN DEU 1 OR DEU 2 POSITION (FOR HOT BATTERY BUS OR DATA LOAD SWITCH, CDS FAULT IS REMOVED WHEN BOTH ENGINES START.)
2 DSPLY SOURCE	SHOWS AFTER 2ND ENGINE STARTED FOR A CDS FAULT: DEU FAILURE, BOTH PARTIAL FAILURE, INCOMPATIBLE S/W OR H/W, OR CRITICAL DATA MISCOMPARE OR WHEN YOU SELECT ALL ON 1 (2).

CDS MAINTENANCE MESSAGES

Figure 53 CDS- GENERAL DESCRIPTION

Reference to Figure 54 CDS-Manual Switching

31−62 COMMON DISPLAY SYSTEM

GENERAL

Outboard Display Unit:

If the outboard display unit has a failure, the inboard display unit shows the primary flight display.

Inboard Display Uni:

If the inboard display unit has a failure, the navigation display does not show.

Upper Center Display Unit:

If the upper center display unit has a failure, the lower center display unit shows the primary engine display.

If the secondary engine display already shows on the lower center display unit, the compacted engine display shows.

CDS − SWITCHING/MANUAL SWITCHING

1 NORMAL POSITION

When you select NORM, the normal displays show on all the display units.

These are the normal displays:

- Left outboard:
  - captain's primary flight display
- Left inboard:
  - captain's navigation display
- Upper center:
  - engine primary display
- Lower center:
  - engine secondary display
- Right inboard:
  - FO's navigation display
- Right outboard:
  - FO's primary flight display.

At power−up, each display unit reads its position pins and calculates its position. The position latches into the DU memory.

If a DU fails to read the position pins, the DU is blank.

At power−up, the lower center display unit shows the secondary engine display.

After power−up, with the display select panel lower DU selector in the NORM position, you can use the ENG switch or the SYS switch to control the format that shows on the lower center display unit.

2 OUTBD PFD POSITION

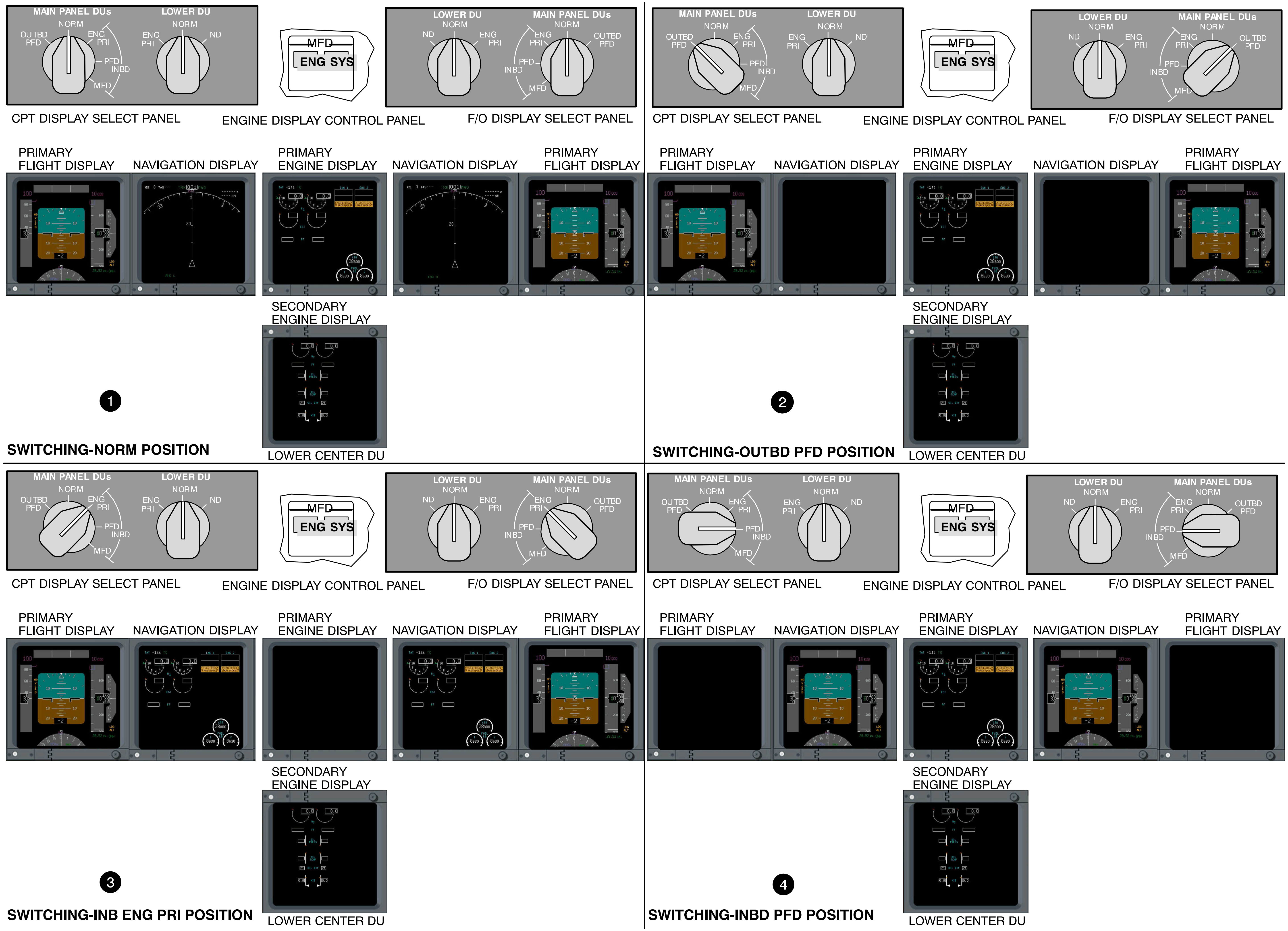
When you select OUTBD PFD, the primary flight display shows on the outboard display unit.
The inboard display unit does not show data.

3 INBD ENGINE PRI POSITION

When you select INBD ENGINE PRI, the primary engine display shows on the inboard display unit.
The navigation display does not show and the upper center display unit does not show display data.

4 INBOARD PFD POSITION

When you select INBD PFD, the primary flight display shows on the inboard display unit. The outboard display unit does not show display data.


MAIN PANEL DUs
LOWER DU
NORM
OUTBD PFD
ENG PRI
PFD
INBD
MFD
ND
MFD
ENG SYS
CPT DISPLAY SELECT PANEL
ENGINE DISPLAY CONTROL PANEL
F/O DISPLAY SELECT PANEL
PRIMARY FLIGHT DISPLAY
NAVIGATION DISPLAY
PRIMARY ENGINE DISPLAY
SECONDARY ENGINE DISPLAY
LOWER CENTER DU
1
SWITCHING-NORM POSITION
2
SWITCHING-OUTBD PFD POSITION
3
SWITCHING-INB ENG PRI POSITION
4
SWITCHING-INBD PFD POSITION

Reference to Figure 49 CDS-Manual Switching Cont.

1 INBD MFD POSITION

When you select INBD MFD, you can use the two switches on the engine display control panel to select the MFD (**M**ulti **F**unction **D**isplay) format.
If you select ENG, the engine secondary display shows on the inboard display unit.
If you select SYS, the systems display shows on the inboard display unit.

2 LOWER ENGINE PRIMARY POSITION

When you select LOWER ENG PRI, the primary engine display shows on the lower center display unit. The upper center display unit does not show data.

3 LOWER ND POSITION

If you select LOWER ND, the lower center display unit shows the navigation display.
If both the captain and the first officer select LOWER ND on their display select panels then the captain's navigation display shows on the lower center display unit.

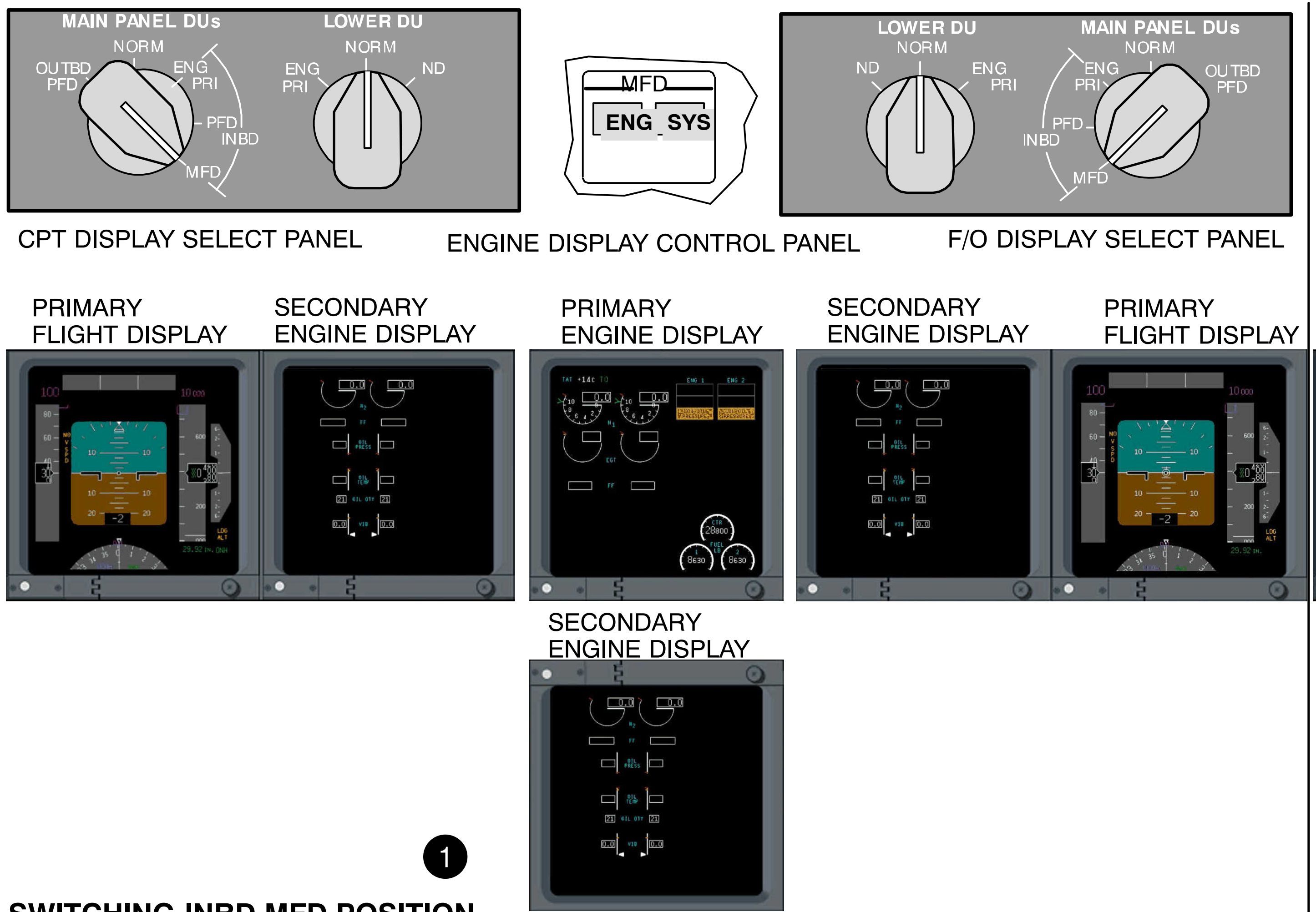
CDS-SOURCE SELECT

4 CDS-SOURCE SELECT

Displays Source Selector:

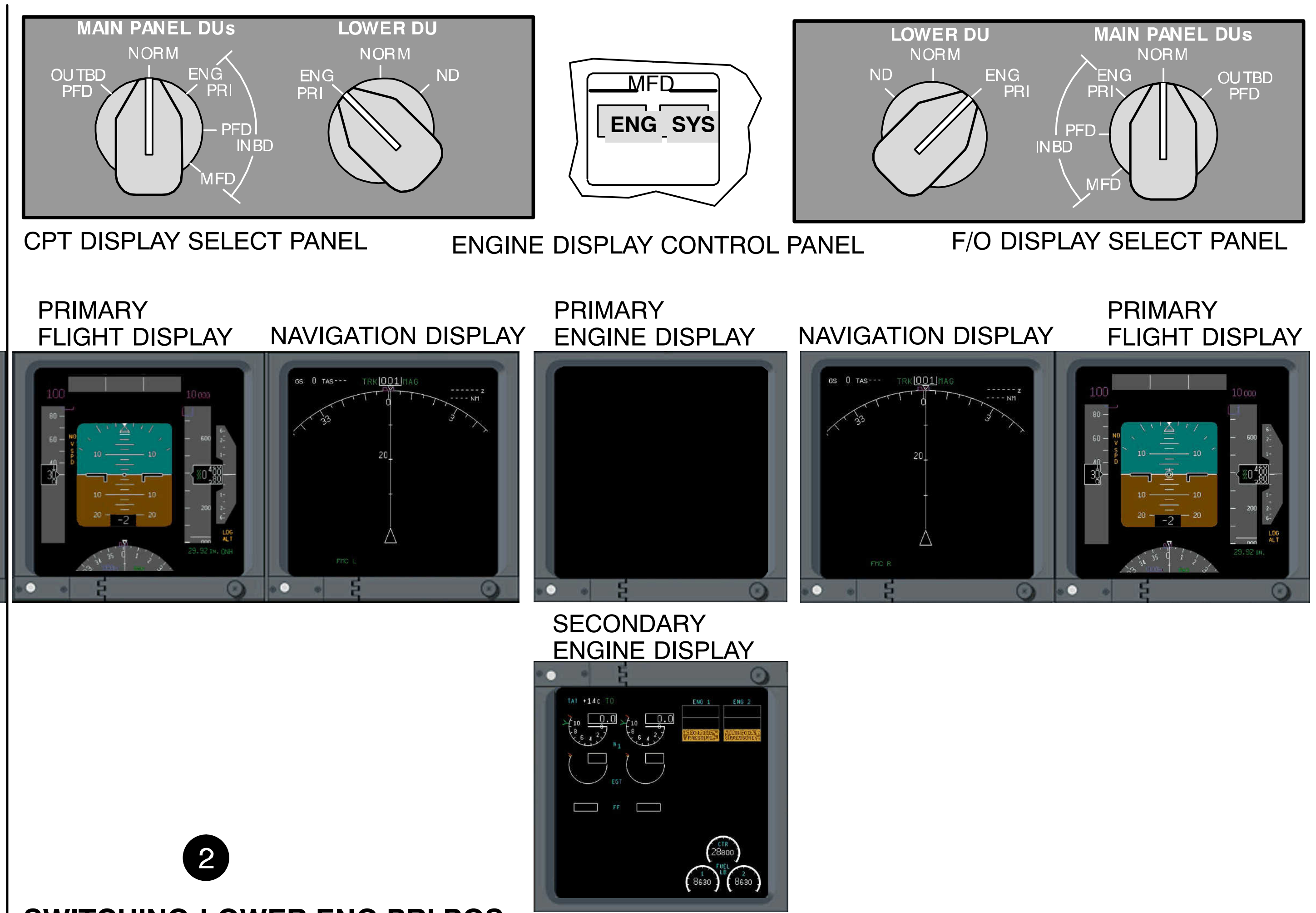
The display source selector lets you select the DEUthat controls the displays.
When the selector is in the AUTO position and If any of the graphics generators circuit card assemblies fails in either DEU, the DEUs automatically change the GG that controls the display units.
The pilots may select manually (if they consider a DEU as faulty) the DEU 1 or DEU 2 as the source for all 6 displays in the flight deck.

NOTE: As a caution for pilots, DSPLY SOURCE is displayed in amber in both PFDs with SOURCE SELECT SWITCH in position ALL ON 1 or ALL ON 2. This should make Pilots aware that comparison of critical data is not possible anymore.



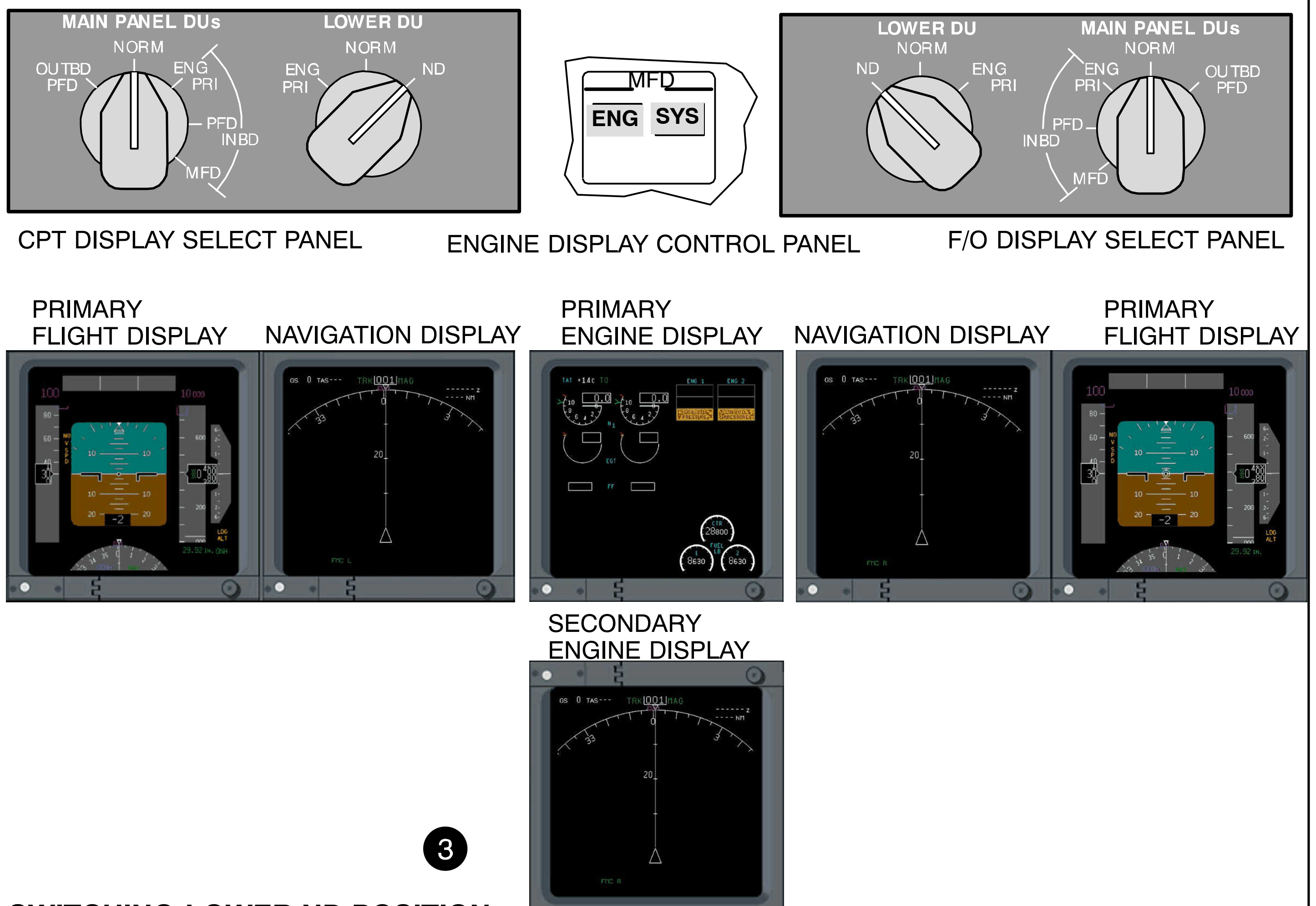
SWITCHING-INBD MFD POSITION

LOWER CENTER DU



SWITCHING-LOWER ENG PRI POS

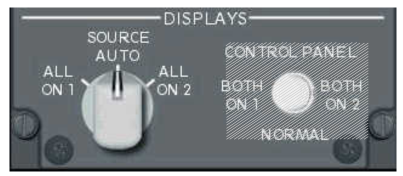
LOWER CENTER DU



SWITCHING-LOWER ND POSITION

LOWER CENTER DU

GG=GRAPHIC GENERATOR



4

SELECTOR POSITION		DU: LOB	LIB	UPPER C	LOWER C	RIB	ROB
AUTO	FAILURES NONE	DEU 1 GG A	DEU 1 GG A	DEU 1 GG B	DEU 2 GG A	DEU 2 GG B	DEU 2 GG B
	DEU 1 GG A	DEU 1 GG B	DEU 1 GG B	DEU 2 GG A	DEU 2 GG A	DEU 2 GG B	DEU 2 GG B
	DEU 1 GG B	DEU 1 GG A	DEU 1 GG A	DEU 2 GG A	DEU 2 GG A	DEU 2 GG B	DEU 2 GG B
	DEU 2 GG A	DEU 1 GG A	DEU 1 GG A	DEU 1 GG B	DEU 1 GG B	DEU 2 GG B	DEU 2 GG B
	DEU 2 GG B	DEU 1 GG A	DEU 1 GG A	DEU 1 GG B	DEU 1 GG B	DEU 2 GG A	DEU 2 GG A
	DEU 1 GG A & B	DEU 2 GG A	DEU 2 GG A	DEU 2 GG A	DEU 2 GG B	DEU 2 GG B	DEU 2 GG B
	DEU 2 GG A & B	DEU 1 GG A	DEU 1 GG A	DEU 1 GG A	DEU 1 GG B	DEU 1 GG B	DEU 1 GG B
	DEU 1 GG A DEU 2 GG A	DEU 1 GG B	DEU 1 GG B	DEU 1 GG B	DEU 2 GG B	DEU 2 GG B	DEU 2 GG B
	DEU 1 GG A DEU 2 GG B	DEU 1 GG B	DEU 1 GG B	DEU 1 GG B	DEU 2 GG A	DEU 2 GG A	DEU 2 GG A
	DEU 1 GG B DEU 2 GG A	DEU 1 GG A	DEU 1 GG A	DEU 1 GG A	DEU 2 GG B	DEU 2 GG B	DEU 2 GG B
	DEU 1 GG B DEU 2 GG B	DEU 1 GG A	DEU 1 GG A	DEU 1 GG A	DEU 2 GG A	DEU 2 GG A	DEU 2 GG A
ALL ON 1		DEU 1 GG A	DEU 1 GG A	DEU 1 GG A	DEU 1 GG B	DEU 1 GG B	DEU 1 GG B
ALL ON 2		DEU 2 GG A	DEU 2 GG A	DEU 2 GG A	DEU 2 GG B	DEU 2 GG B	DEU 2 GG B

1 COAX OUTPUT 1 = GG A
COAX OUTPUT 2 = GG B

CDS - SOURCE SELECT

1 DU LOOP TESt MENU Page

To do the Loop Test select LSK 2L. On the DU LOOP TEST MENU page you can select two tests.To operate the first test, select LSK 2L. This makes the graphics generator (GG) circuit card assembly (CCA) A (coax 1) transmit data to the left DUs and the upper center DU; and the GG CCA B (coax 2) transmit data to the right DUs and the lower center DU. To operate the second test, select LSK 4L. This makes the graphics generator (GG) circuit card assembly (CCA) B (coax 2) transmit data to the left DUs and the upper center DU; and the GG CCA A (coax 1) transmit data to the right DUs and the lower center DU.

2 Display Unit Display

When you operate the DU loop test, the display units show this information:

- DU location
- ARINC 429 loop status
- Remote light sensor brightness value Coax output source
- Coax cable input activity Bezel light sensor brightness value
- Unit brightness value.
- DU location show

An invalid DU location shows as BAD.
The AR INC 429 loop status shows the status of the AR INC 429 bus from the DU to the DEUs. A PASS or FAIL shows. The remote light sensor brightness value shows as a percentage of maximum value.
The range is 0 to 100. BAD shows if the input is bad.
The coax output shows the GG CCA that transmits data to the display unit. The coax cable input activity shows the status of the four coax cable inputs to the DU. A Y for yes and a N for no shows. A white highlight box shows around the specific coax cable input that currently transmits to the DU. From left to right the letters refer to these coaxial couplers:

- First letter for coax coupler 1 from DEU 1, GG A
- Second letter for coax coupler 2 from DEU 1, GG
- Third letter for coax coupler 4 from DEU 2, GG A
- Fourth letter for coax coupler 3 from DEU 2, GG B.

The bezel light sensor brightness value, the WXR brightness values (LIB/RIB/LWR only) and the unit brightness values show as a percentage of maximum value. BAD shows if the input is bad. This values change if you change the unit brightness.

3 DU OPTICAL TEST MENU Page

To do the DU optical test, select LSK 3L. This shows the DU OPTICAL TEST MENU page. You do these tests to examine the DU liquid crystal display (LCD).

The DU BITE circuits do not monitor the LCD quality. These are the five tests that you can select:

- RED
- BLUE
- GREEN
- WHITE
- STRIPE

To do the RED test select LSK 1L. This makes all the DU show a solid red display.The other Colours are the same.

4 DU Colour/Stripe Test Indications

For the Colour Test, the Dus show all the same Colour. This lets you see single defects easily.For the STRIPE test, the DUs show diagonal white and black stripes. This test lets you see line defects easily.

5 SELF TEST MENU PAGE

The SELF TEST MENU page shows information about the self test, it can take up to 180 seconds because if the test fails the first time, the DEU internally runs the test a second time before it reports a fault. When the you select RUN on the SELF TEST MENU page, the SELF TEST WAIT page shows Test in Progress.

6 PASSED or SELF TEST FAILURES Page

When the self-test is over, the CDU shows the results. If the DEU is OK, the CDU shows DEU SELF-TEST PASSED. If the DEU senses faults during the self-test, the CDU shows SELF-TEST FAILED.

7 CURRENT STATUS PAGE

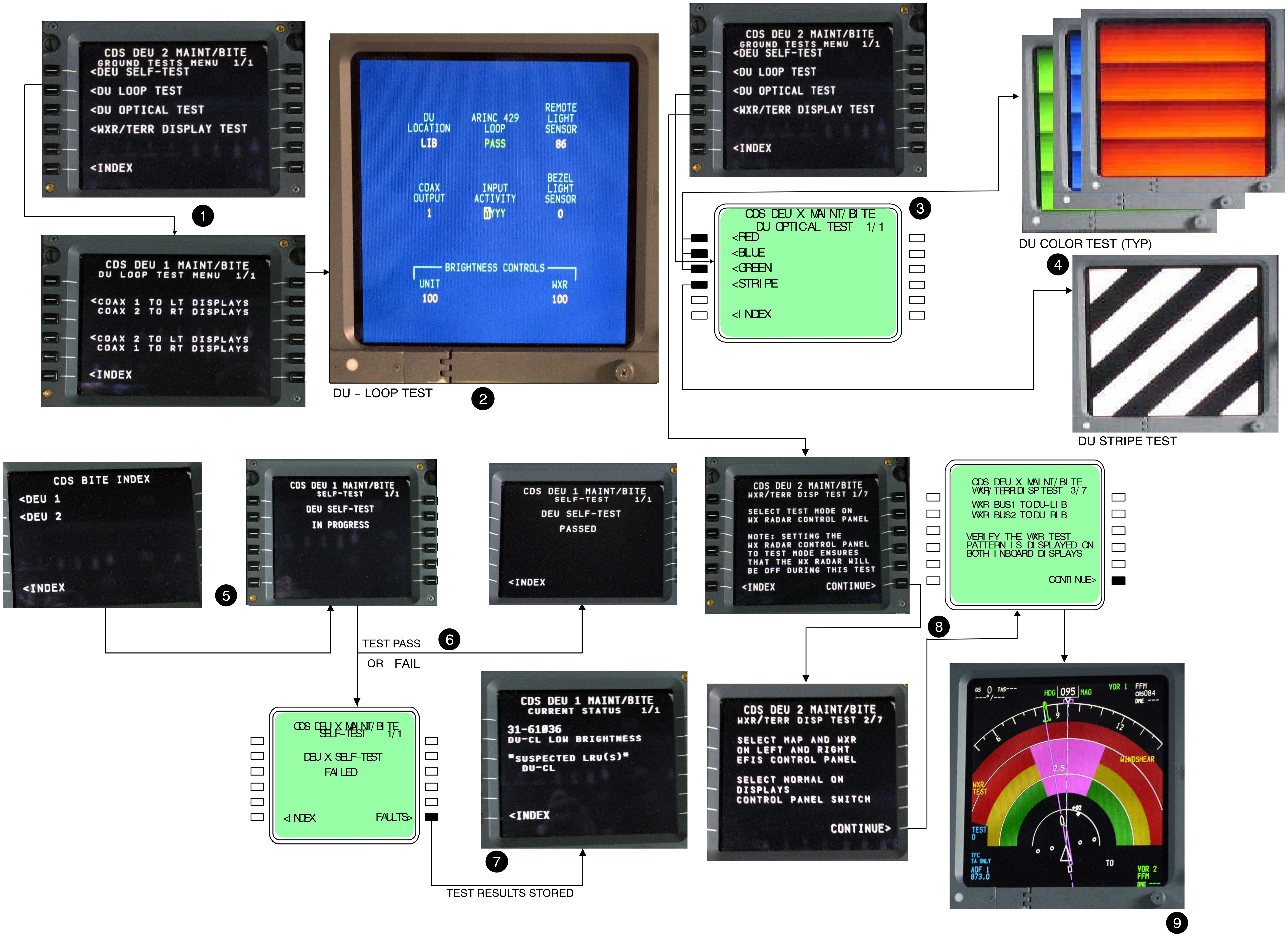
Shows you detailed Information about the failed Test, Maintenance Messages and suspected failed LRUs.

8 WXR/TERR DISP TEST

To do the weather radar display test and the terrain display test, select LSK4L. This shows the WXR/TERR DISPLAY TEST page. You do these tests to verify the weather radar and GPWS ARINC 453 interfaces to the DEUs. Select the test mode on the weather radar control panel. Then select the map mode and the WXR switch on the EFIS control panels.

9 TEST INDICATION

The weather radar pattern shows on the display units. If one of the weather radar test patterns does not show when you do the test, the ARINC 453 interface to the graphics generator is bad.


CDS DEU 2 MAINT/BITE
GROUND TESTS MENU 1/1
<DEU SELF-TEST
<DU LOOP TEST
<DU OPTICAL TEST
<WXR/TERR DISPLAY TEST
<INDEX
1
CDS DEU 1 MAINT/BITE
DU LOOP TEST MENU 1/1
<COAX 1 TO LT DISPLAYS
COAX 2 TO RT DISPLAYS
<COAX 2 TO LT DISPLAYS
COAX 1 TO RT DISPLAYS
<INDEX
DU LOCATION
LIB
ARINC 429 LOOP
PASS
REMOTE LIGHT SENSOR
86
COAX OUTPUT
1
INPUT ACTIVITY
YYYY
BEZEL LIGHT SENSOR
0
BRIGHTNESS CONTROLS
UNIT
100
WXR
100
DU – LOOP TEST
2
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GROUND TESTS MENU 1/1
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<DU LOOP TEST
<DU OPTICAL TEST
<WXR/TERR DISPLAY TEST
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DU OPTICAL TEST 1/1
<RED
<BLUE
<GREEN
<STRIPE
<INDEX
3
DU COLOR TEST (TYP)
4
DU STRIPE TEST
CDS BITE INDEX
<DEU 1
<DEU 2
<INDEX
5
CDS DEU 1 MAINT/BITE
SELF-TEST 1/1
DEU SELF-TEST
IN PROGRESS
CDS DEU 1 MAINT/BITE
SELF-TEST 1/1
DEU SELF-TEST
PASSED
<INDEX
TEST PASS
6
OR FAIL
CDS DEU 2 MAINT/BITE
WXR/TERR DISP TEST 1/7
SELECT TEST MODE ON
WX RADAR CONTROL PANEL
NOTE: SETTING THE
WX RADAR CONTROL PANEL
TO TEST MODE ENSURES
THAT THE WX RADAR WILL
BE OFF DURING THIS TEST
<INDEX
CONTINUE>
CDS DEU X MAINT/BITE
WXR/TERR DISP TEST 3/7
WXR BUS1 TO DU-LIB
WXR BUS2 TO DU-RIB
VERIFY THE WXR TEST
PATTERN IS DISPLAYED ON
BOTH INBOARD DISPLAYS
CONTINUE>
8
CDS DEU X MAINT/BITE
SELF-TEST 1/1
DEU X SELF-TEST
FAILED
<INDEX
FAULTS>
CDS DEU 1 MAINT/BITE
CURRENT STATUS 1/1
31-61036
DU-CL LOW BRIGHTNESS
SUSPECTED LRU(S)
DU-CL
<INDEX
7
TEST RESULTS STORED
CDS DEU 2 MAINT/BITE
WXR/TERR DISP TEST 2/7
SELECT MAP AND WXR
ON LEFT AND RIGHT
EFIS CONTROL PANEL
SELECT NORMAL ON
DISPLAYS
CONTROL PANEL SWITCH
CONTINUE>
HDG 095 MAG
VOR 1
WINDSHEAR
WXR TEST
TEST
VOR 2
9

Reference to Figure 1 Landing Gear Overview

ATA 32 LANDING GEAR
32-31 LANDING GEAR CONTROL SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

Hydraulic system A normally supplies pressure to the landing gear extension and retraction. Hydraulic system B supplies pressure for retraction only through the landing gear transfer valve. You move the landing gear control lever to control landing gear extension and retraction.

1 Landing Gear Control Lever

The landing gear control lever assembly operates the landing gear selector valve through control cables. The landing gear control lever has these three positions with detents:

- UP
- OFF
- DOWN.

You must first pull the control lever out before you can move the lever. The control lever assembly has a lever lock mechanism operated by a lever lock solenoid. The lever lock prevents accidental movement of the landing gear lever to the up position when the airplane is on the ground. When the airplane takes off, the solenoid gets electrical power and releases the lever lock.

2 Landing Gear Transfer Valve

The landing gear transfer valve changes the pressure supply for landing gear retraction from hydraulic system A to hydraulic system B. The landing gear transfer valve receives electrical signals from the proximity switch electronics unit (PSEU).

All of these conditions cause the landing gear transfer valve to move automatically to the alternate position:

- Airplane in the air
- Landing gear lever not down
- One main landing gear not up
- Left engine N2 speed less than 50%
- Hydraulic system B pressure supplied to valve.

These conditions cause the manual operation of the landing gear transfer valve:

- Alternate nose wheel steering switch to the alternate position
- Normal quantity in system B reservior
- Nose air/ground system in air mode.

3 Landing Gear Selector Valve

The landing gear selector valve supplies pressure to extend and retract the main landing gear and the nose landing gear. The control lever moves the selector valve. The selector valve also gets an electrical input from the manual extension system. This operates a bypass valve in the selector valve to connect the landing gear retraction to the hydraulic system return.

4 Main Landing Gear Actuator

The main landing gear actuator retracts to extend the main landing gear. The main landing gear actuator extends to retract the main landing gear. The restrictor on the retract pressure port of the actuator slows fluid pushed from the actuator during gear extension. The check valve permits full flow into the actuator during landing gear retraction.

5 Main Landing Gear Uplock Actuator

During main landing gear extension, the uplock actuator receives pressure to retract. The actuator moves the uplock mechanism to the unlocked position.

6 Main Landing Gear Downlock Actuator

The actuator retracts to lock the downlock mechanism during main landing gear extension. The actuator extends to unlock the downlock mechanism during main landing gear retraction.

7 Transfer Cylinder

During the extension and retraction sequences, the transfer cylinder gives a time delay. This lets the gear unlock before the gear actuator receives pressure.

8 Frangible Fitting

The frangible fitting removes up pressure from the main landing gear actuator when a damaged, spinning tire moves into the main landing gear wheel well. This prevents damage to components in the wheel well.

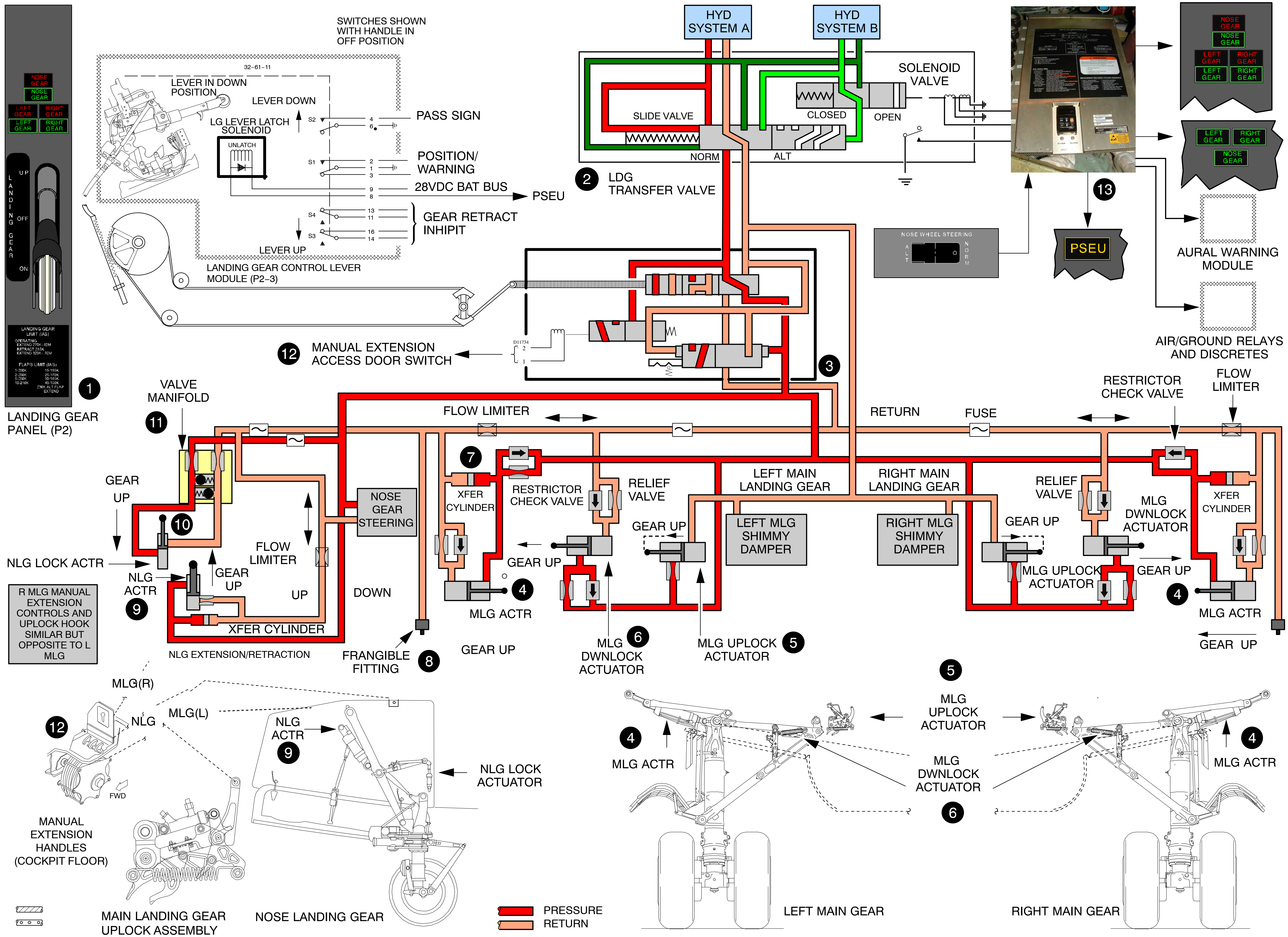


Figure 57 Landing Gear Overview

Reference to Figure 1 Landing Gear Overview (Cont.)

SYSTEM DESCRIPTION (CONT.)

9 Nose Landing Gear Actuator

The actuator retracts to extend the nose landing gear. The actuator extends to retract the nose landing gear.

10 Nose Landing Gear Lock Actuator

The NLG lock actuator unlocks the NLG lock mechanism at the start of an extension or retraction sequence. The lock actuator also locks the lock mechanism when the NLG moves to the fully extended or retracted positions.

11 Valve Manifold

The valve manifold controls hydraulic fluid flow to and from the nose gear lock actuator. It also limits hydraulic pressure in the lock actuator during retraction and extension.

12 Manual Extension Control

The manual extension control mechanism transmits inputs by control cables from the manual extension handles to the release the up-lock mechanism of the nose landing gear and extension linkages of the main landing gears. A door position switch below the access door sends a signal to the manual extend solenoid valve.

13 Proximity Switch Electronics Unit

The PSEU does these functions:

- Air/ground signals
- Landing gear position indication and warning
- Landing gear transfer valve control
- Landing gear not down warning
- Takeoff (aural) warning
- Door warning
- Speedbrakes extended amber light control
- Emergency overwing exit flight lock

The PSEU also provides fault indication and maintenance BITE.

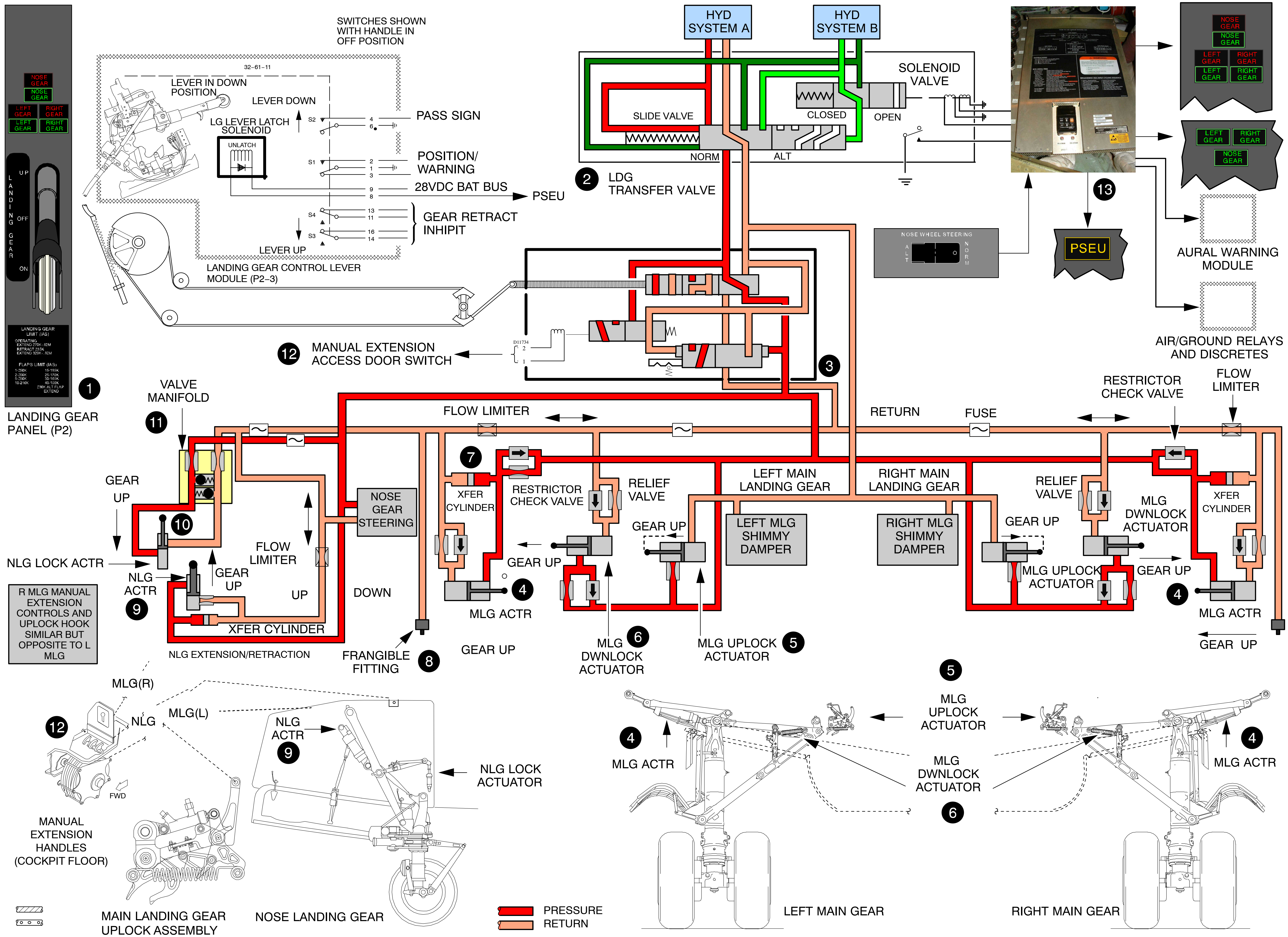


Figure 58 Landing Gear Overview (Cont.)

Reference to Figure 1 Brake and Antiskid System

32-41 HYDRAULIC BRAKE SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

Each main wheel is provided with a hydraulic actuated, multidisc brake unit. Brakes can be applied manually with the captain's or first officer's brake pedals or automatically by an autobrake system controlled with a selector switch. An antiskid system modulates applied pressure to provide maximum effective braking on any runway surface condition.

If hydraulic system B supplies pressure, the normal brake system uses hydraulic system B pressure tooperate the brakes.

When the hydraulic systems A and B do not supply pressure, the brake accumulator supplies pressure to the normal brake system.

During landing gear retraction, the alternate brake system gets pressure to operate the brakes. This stops wheel rotation before the landing gear retracts.

1 Normal Brake Metering Valves

The normal brake metering valves get input from the brake pedals and send out metered brake pressure. They use hydraulic system B or accumulator pressure.

2 Alternate Brake Metering Valves

The alternate brake metering valves get input from the brake pedals and send out metered brake pressure. They use hydraulic system A pressure for the alternate brake system when hydraulic system B does not supply pressure. They also use pressure from the landing gear retract line to stop the main gear wheel rotation during retraction.

3 Normal Antiskid Valves

Four antiskid valves in the normal hydraulic brake system give protection to each wheel during normal brake operation.

4 Alternate Antiskid Valves

Two antiskid valves in the alternate hydraulic brake system each give protection to both wheels on a main landing gear during alternate brake operation.

5 Brake Hydraulic Fuses

Brake hydraulic fuses prevent hydraulic fluid loss if there is an external leak downstream of the fuses.

6 Alternate Brake Selector Valve

The alternate brake selector valve selects and sends hydraulic systems B or A pressure to the normal oralternate brake systems.

7 Alternate Brake Pressure Switch

The alternate brake pressure switch sends a signal to the antiskid system when the alternate brake system receives pressure.

8 Accumulator Isolation Valve

The accumulator isolation valve holds pressure in the brake accumulator when the alternate brake system gets pressure.

9 Brake Accumulator

The brake accumulator supplies brake pressure to the normal brake hydraulic system if there are no other pressure sources. It is also the pressure source for the parking brake system when the hydraulic systems do not supply pressure.

10 Parking Brake Shutoff Valve

The parking brake shutoff valve closes to prevent brake accumulator pressure leakage through the normal antiskid valve return.

11 Autobrake Shuttle Valves

Two autobrake shuttle valves select the highest of normal metered or autobrake pressures and send it to the brakes. The metered pressure switch sends signals to the AACU (**A**ntiskid/**A**utobrake **C**ontrol **U**nit)when the pressure from normal brake metering valve increases to more than 750 PSI.

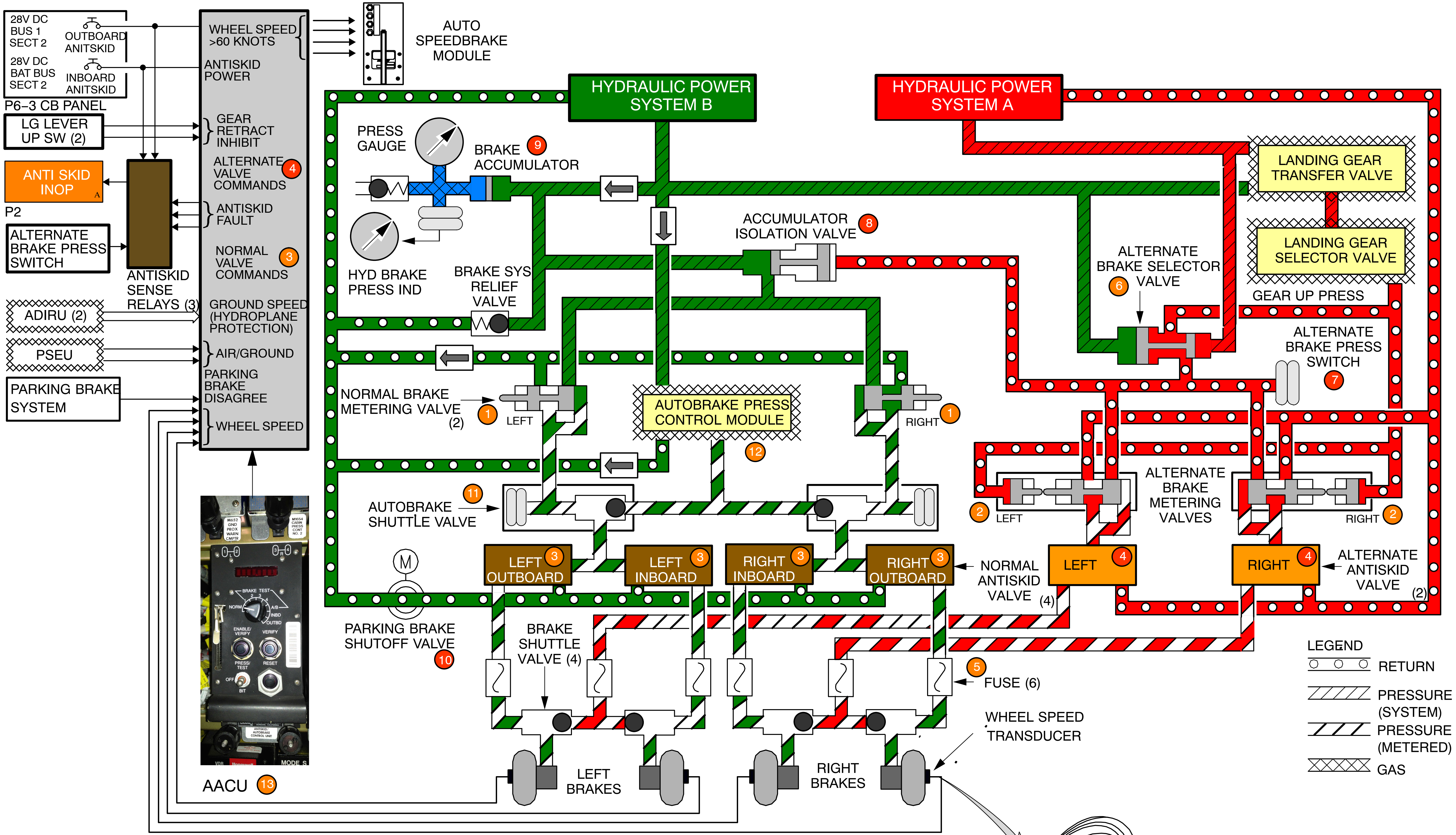
12 Autobrake Pressure Cont. Module

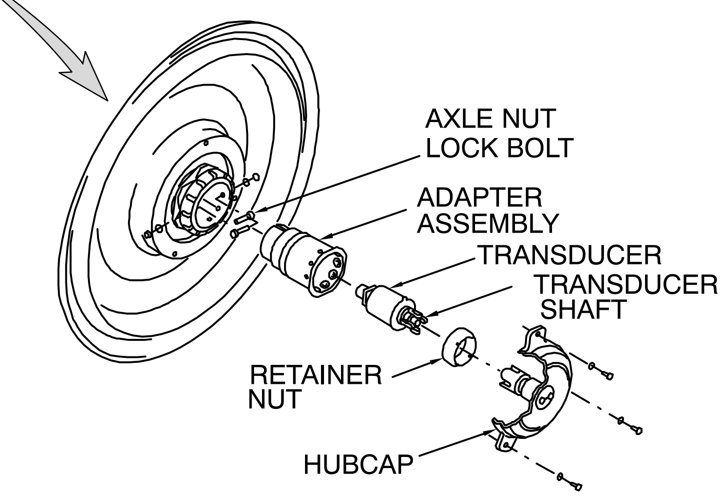
The autobrake pressure control module uses input frorn the antiskid/autobrake control unit to rneter hydraulic system B pressure to the norrnal brake systern during autobrake operation.

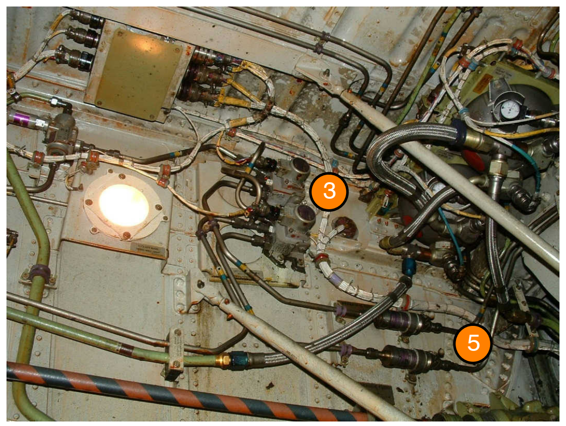
13 Antiskid/Autobrake Control Unit

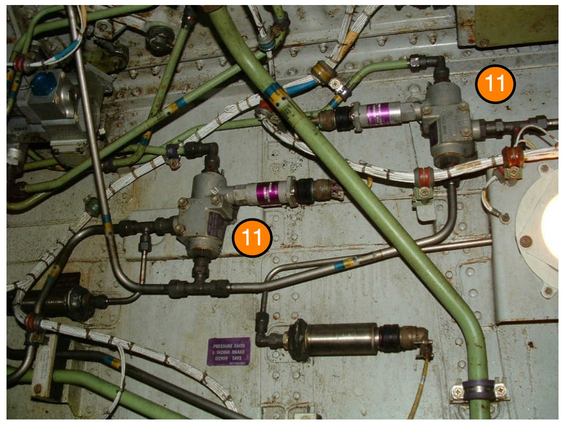
The AACU contains circuit cards for the antiskid and autobrake systems and for the related BITE functions. It sends brake release inputs to the antiskid valves and brake application inputs to the autobrake pressure control module. It also monitors the antiskid and autobrake systems for faults and does the built in test functions.

LANDING GEAR
HYDRAULIC BRAKE SYSTEM









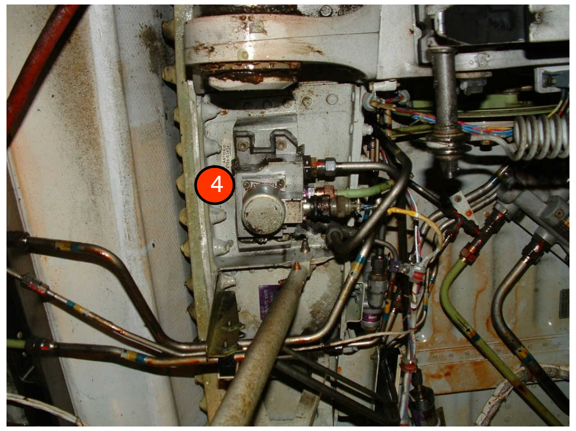


Figure 59 Brake and Antiskid System

ATA 33 LIGHTS

33-20 PASSENGER COMPARTMENT

GENERAL

The passenger signs give these indications to the passengers and attendants:

- NO SMOKING
- FASTEN SEAT BELT
- RETURN TO SEAT.

The passenger sign lights use incandescent lamps. When the NO SMOKING sign and FASTEN SEAT BELT sign switches are in the AUTO position, this occurs:

- The NO SMOKING relay and FASTEN SEAT BELT relay will energize with the landing gear in the down position, or when the oxygen indication relay energizes.
- The FASTEN SEAT BELT relay will energize with the trailing edge flap limit switch in the NOT UP position.

1 Control Panel

Two, three-position toggle switches on the P5 panel control the passenger signs.
These switches are NO SMOKING and FASTEN SEAT BELT.
When you move the NO SMOKING sign or FASTEN SEAT BELT switches to the ON position, 28v ac energizes the related NO SMOKING relay or FASTEN SEAT BELT relays.
This supplies 28v ac from transfer bus 1 to operate the passenger sign lights and the low chime

2 Flap Limit Relay

When the passenger sign switches are in the AUTO position and the trailing edge flaps limit switch is in the NOT UP position, these indications occur:

- FASTEN SEAT BELT signs come on
- RETURN TO SEAT signs come on
- Low chime operates.

3 Landing Gear Lever Switch

When the passenger signs switches are in the AUTO position and the landing gear lever switch is in the GEAR DOWN position, these indications occur:

- FASTEN SEAT BELT signs come on
- NO SMOKING signs come on
- RETURN TO SEAT signs come on
- Low chime operates.

4 Oxygen Indication Relay

When the passenger sign switches are in the AUTO position and the oxygen indication relay energizes, these indictions occur:

- FASTEN SEAT BELT signs come on
- NO SMOKING signs come on
- RETURN TO SEAT signs will not come on
- Low chime operates.

5 No Smoking Sign Relay

When the NO SMOKING sign switch is in the AUTO position, this occurs:

- The NO SMOKING relay will energize with the landing gear in the down position, or when the oxygen indication relay energizes.

6 Seat Belt Sign Relay

When the FASTEN SEAT BELT sign switch is in the AUTO position, this occurs:

- The FASTEN SEAT BELT relay will energize with the trailing edge flap limit switch in the NOT UP position or when the oxygen indication relay energizes.

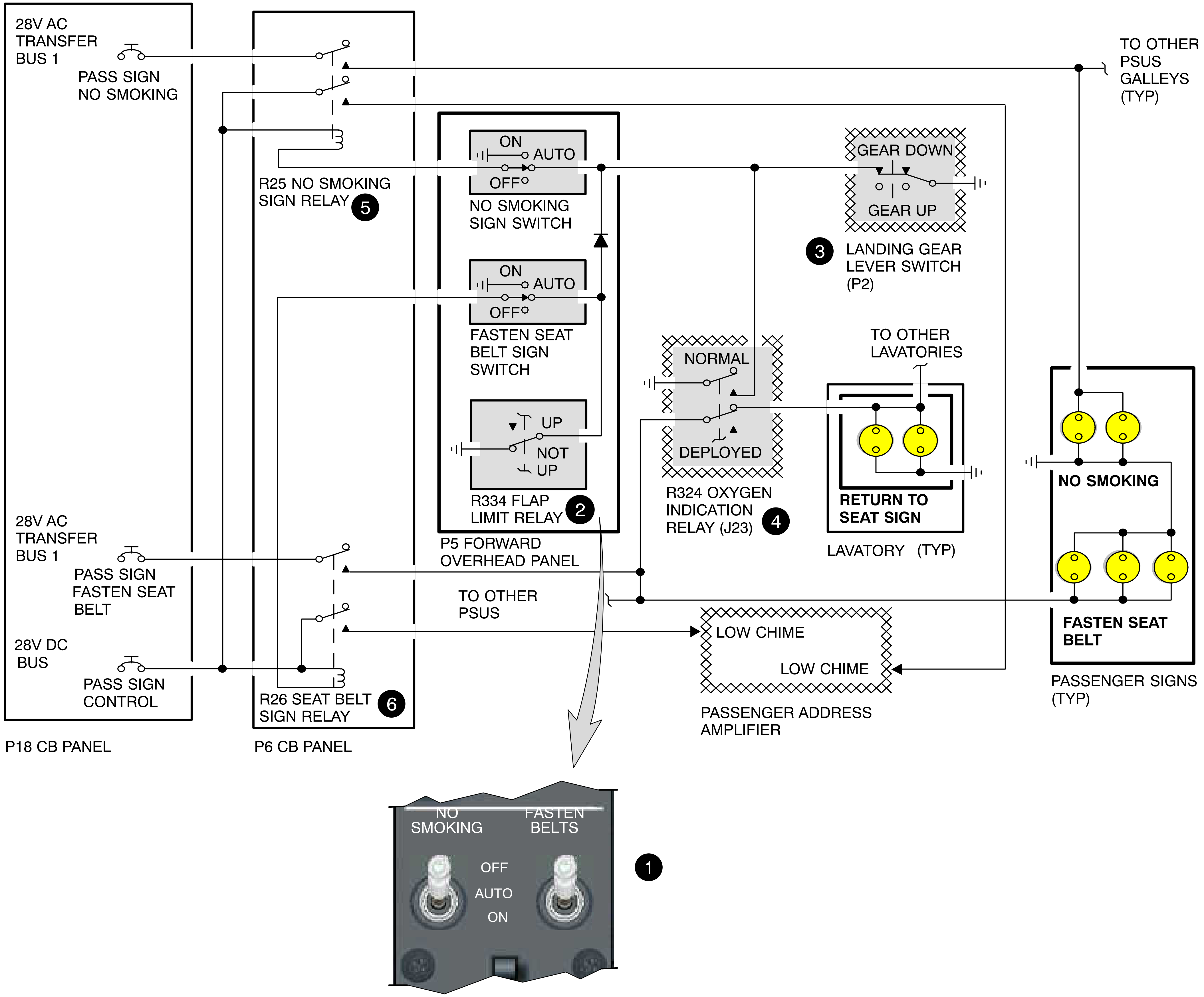


Figure 60 Passenger Signs Schematic

33-40 EXTERIOR LIGHT

GENERAL

The exterior lights supply light for airplane identification, direction, and to aid in the safe operation of the airplane.
These are the exterior lights on the airplane:

1 Control Panel

These are the switches on the P5 that control the external lights:

- Landing (retractable and fixed)
- Runway turnoff
- Logo
- Position
- Anti-collision
- Wing
- Wheel Well
- Taxi.

2 Wing Illumination

The wing illumination lights supply light to the leading edge of the wings. At night, this lets the pilots see when ice collects on the wing leading edges.

3 Fixed Landing Lights

The landing lights help the pilots to see the runway for takeoff and landing.
There are two types of landing lights, fixed and retractable. With the fixed landing light switch in the ON position, 115v ac goes to the step down transformer. The step down transformer decreases the voltage to 28v ac.

4 Retractable Landing Lights

The retractable landing light uses115v ac to extend and retract the light.
With the retractable landing light switch in the

RETRACT

RETRACT position,115v ac goes to the retract motor in the light. The light will retract until the full retract limit switch opens.

EXTEND

With the switch in the EXTEND position, 115v ac goes to the extend motor in the light. The light will extend until the full extend limit switch opens.

ON

With the switch in the ON position, the landing light will extend. When the light is within five degrees of full extension the light will come on.

5 Taxi and Runway Turnoff Lights

Taxi and runway turnoff lights let the pilots see the taxiway or runway as the airplane taxis.
You use three switches on the P5 panel to control the taxi and runway lights.
There is one switch for the nose gear taxi light and one switch for each runway turnoff light.

6 Logo Lights

The logo lights help show the airline logo or emblem on the vertical stabilizer.
With the toggle switch in the ON position, 115v ac will go to the logo light. The logo light has a step-down transformer. The transformer decreases the 115v ac to 12v ac.

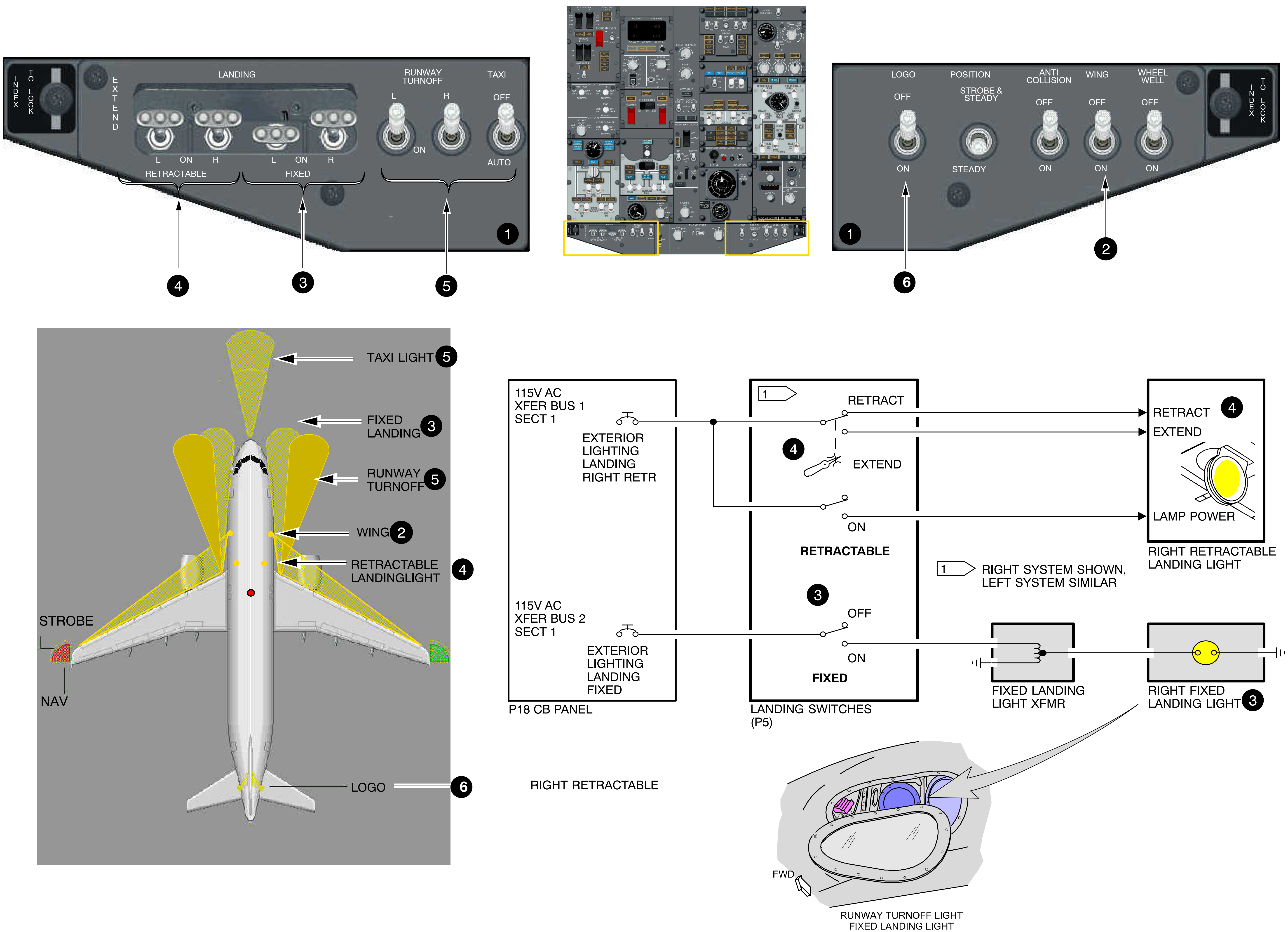


Figure 61 Exterior Lights

33-40 EXTERIOR LIGHTING

GENERAL-ANTI-COLLISION LIGHTS

The ant-collision lights make the airplane easier to see in the air and on the ground.
There are five anti-collision lights on the airplane:

- Two red anti-collision lights
- three white anti- collision lights.

Each light assembly has a xenon arc flashtube and solid state circuits to operate the flashtube.
With the control switch in the STROBE and STEADY position, 115v ac goes to the power supplies for each anti-collision light.

1 White Anti-collision Lights

Control switches for the anti-collision lights are on the P5 forward overhead panel.
There is a control switch for each anti-collision system.
The anti-collision lights flash at a rate of 42 times per minute.
The red anti-collision lights flash at the same time.

2 Red Anti-collision Lights

Control switches for the anti-collision lights are on the P5 forward overhead panel.
There is a control switch for each anti-collision system.
The anti-collision lights flash at a rate of 42 times per minute.
The synchronized white ant-collision lights flash at the same time.

3 Position Lights

The position lights show this information to persons in other airplanes or on the ground:

- Airplane position
- Direction
- Attitude.

With the position lights switch in the ON position, 115v ac goes to the step down transformers.
The step down transformers decrease the 115v ac to 10v ac. The 10v ac electrical power goes to the position lights.

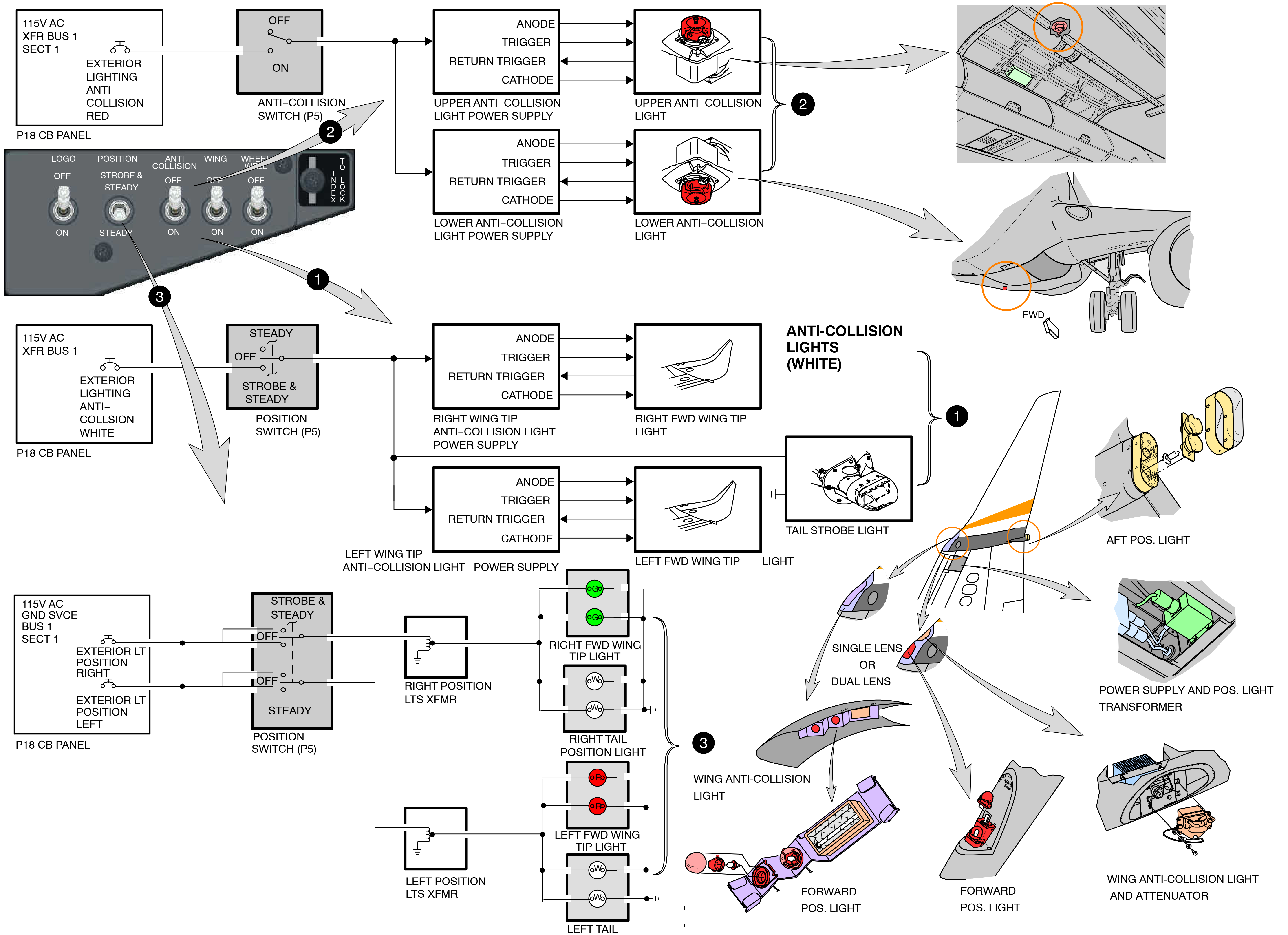


Figure 62 Position/Wing Anti-Collision Lights - Operation

33-00 EMERGENCY LIGHTING

GENERAL

The emergency lighting system has these components:

- Exit signs
- Aisle lights
- Slide lights
- Floor proximity lights
- Power supplies (battery packs)
- Control switches.

The emergency lights use rechargeable battery packs as a power source.
The battery pack assemblies have logic and charging circuits.
The logic controls circuits control light operation and charges the battery packs during normal airplane operations.

1 Control Panel

You use the emergency exit light switch on the P5 forward overhead panel or the emergency exit switch on the attendant panel.
The emergency exit light switch on the P5 panel has these positions:

- ON, makes emergency lights come on
- OFF, prevents automatic operation
- ARM, prepares system for automatic operation.

The NOT ARMED and MASTER CAUTION lights illuminate when the emergency light switch on the P5 panel is in the ON or the OFF position.
The emergency exit switch on the attendant panel has ON and NORMAL positions:

- The ON position makes the emergency lights come on.
- The NORMAL position sets automatic operation.
- The attendant panel switch will cause the lights to come on even if the P5 switch is OFF.

2 Battery Pack

The power supplies use DC-bus No. 1, 28vdc for their charge and control logic circuits.
The charge circuits charge the battery packs when these conditions exist:

- The P5 emergency exit light switch is in the OFF or ARM position.
- 28v dc bus 1 has power.
- The P14 attendant panel emergency exit light switch is in the NORMAL position.

With the P5 switch in the ARM position, the power supply makes the emergency lights come on when one of these conditions occur:

- The attendant panel emergency exit switch is in the ON position.
- 28v dc bus 1 power drops below 12 volts.

3 Aisle Lights

The aisle lights supply light to the general aisle area.

4 Exit Lights

The exit sign lights come on to show the way to the exits.

5 Exit Signs

The exit sign lights come on to show the location of the exits.

6 Floor Proximity Lights (Electric-Type)

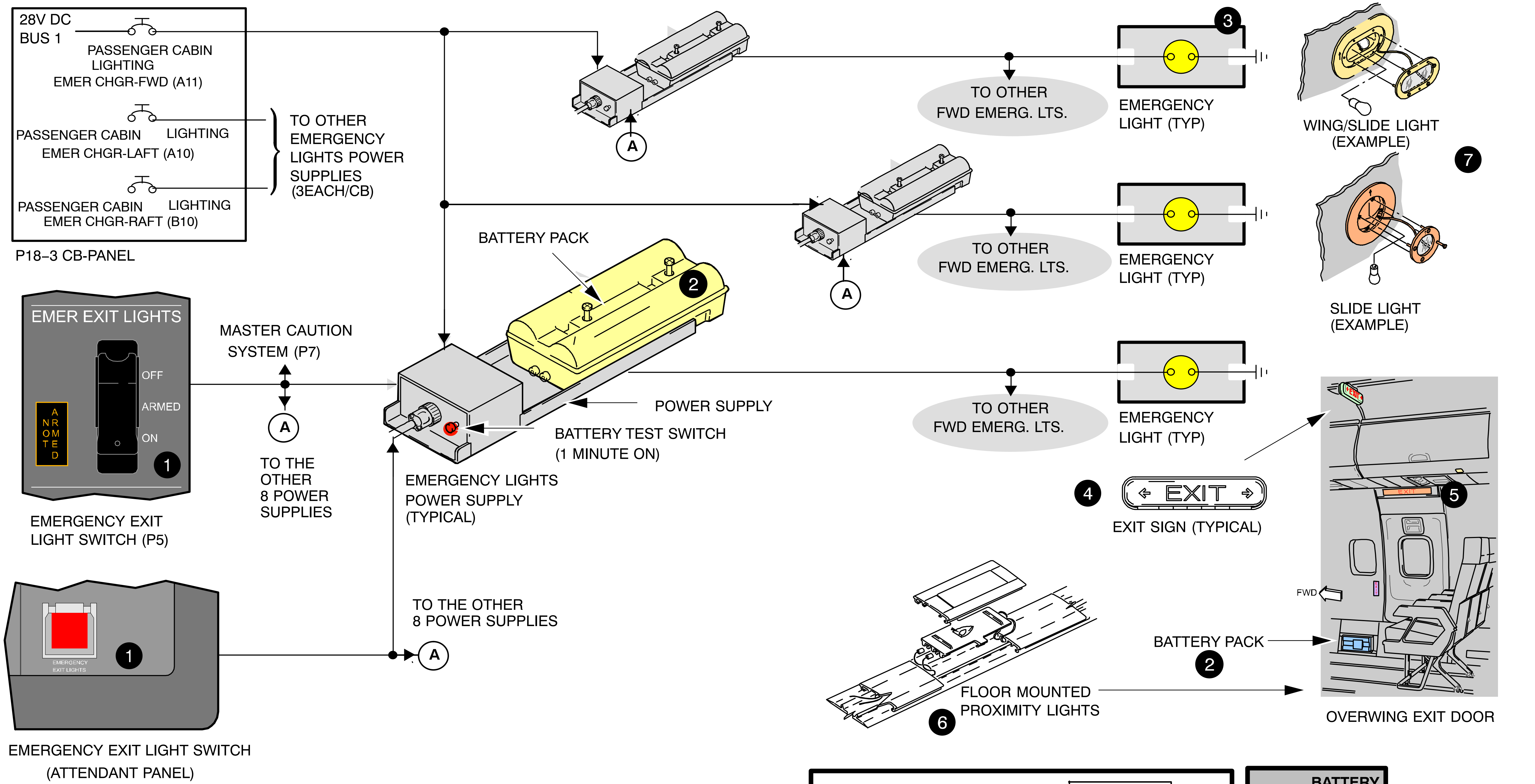
There are different types of floor proximity lights available

- Non-electric type
- Electric-type

The floor proximity lights supply light at the floor level to show the direction to all of the exits.

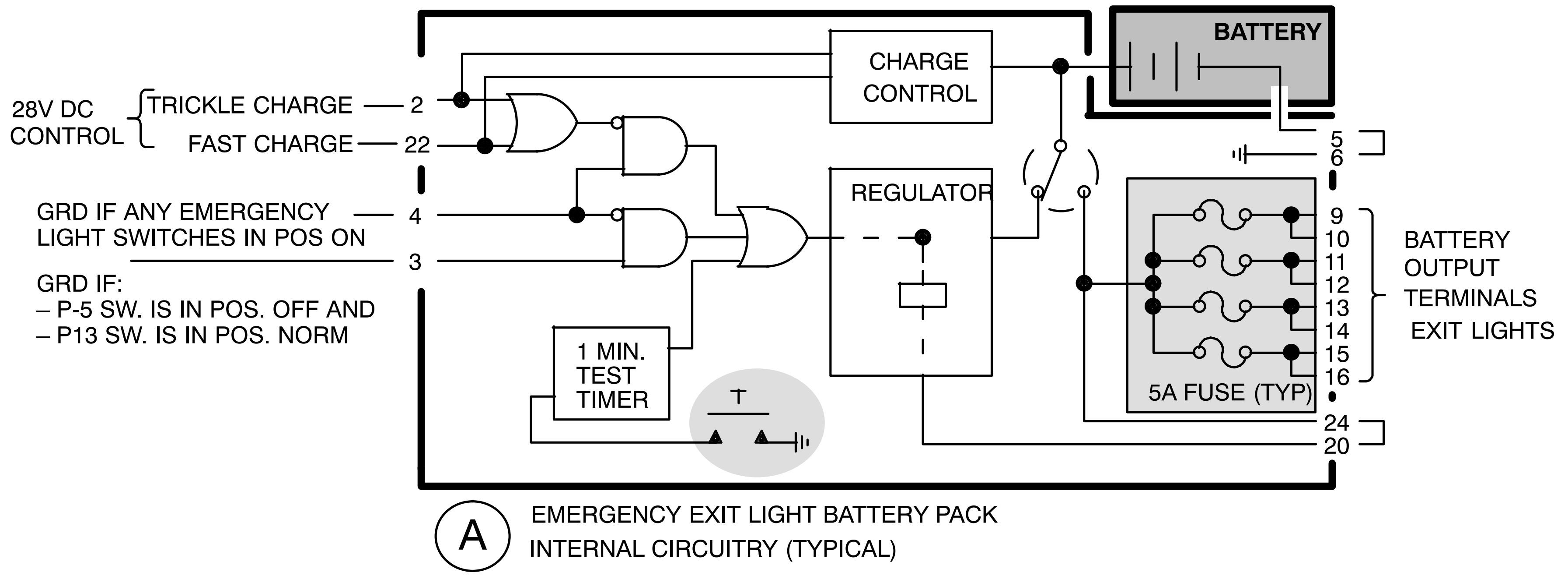
7 Slide Lights

The slide lights supply light to the exit areas around the airplane.



EMERGENCY EXIT LIGHTS	28V DC BUS	LIGHT SW ATT PANEL	LIGHT SW P5 PANEL	BATTERY PACKS
ON	<12V	NORMAL	ARMED	DISCHARGE
ON	<12V	NORMAL	ON	DISCHARGE
OFF	<12V	NORMAL	OFF	CHARGE
ON	<12V	ON	OFF	DISCHARGE
OFF	>12V	NORMAL	ARMED	CHARGE
ON	>12V	NORMAL	ON	DISCHARGE
OFF	>12V	NORMAL	OFF	CHARGE
ON	>12V	ON	ARMED	DISCHARGE
ON	>12V	ON	ON/OFF	DISCHARGE

EMERGENCY EXIT LIGHTS OPERATION AND BATTERY PACK CHARGE LOGIC



A EMERGENCY EXIT LIGHT BATTERY PACK INTERNAL CIRCUITRY (TYPICAL)

Figure 63 Emergency Lighting Schematic

ATA 34 NAVIGATION

34-11 AIR DATA SYSTEM

GENERAL

The purpose of the static and total air pressure system is to measure pitot and static air pressure. These pressures are used to calculate flight parameters such as airspeed and altitude. The static and total air pressure system gets air pressure inputs from three pitot probes and six static ports on the airplane fuselage.

1 Primary Static and Total Air Pressure System

The two primary pitot probes connect to two pitot ADMs (**A**ir **D**ata **M**odules).

Two pairs of the primary static ports connect to two static ADMs.

2 Alternate Static and Total Air Pressure System

The auxiliary pitot probe connects to the standby altimeter/airspeed indicator.

The alternate static ports connect to the standby altimeter/airspeed indicator
and to the cabin differential pressure indicator.

3 Pitot ADMs, Static ADMs

The ADM supply static and pitot air pressure to the ADR processor.

The ADM's change the air pressures to electrical signals and sends them to the ADIRU (**A**ir **D**ata **I**nertial **R**eference **U**nits) on ARINC 429 data buses.

4 AOA Sensors

AOA (**A**ngle **O**f **A**irflow) data is converted from analog data to digital data by the A/D converter before the data is received by the ADR processor.
There are two resolvers in each AOA sensor.

The AOA data from the two resolvers in the left AOA sensor go to the left ADIRU and to the SMYD 1.

The AOA data from the two resolvers in the right AOA sensor goes to the right ADIRU and to the SMYD 2.

5 TAT Probe

TAT (**T**otal **A**ir **T**emperature) from the ADIRUs shows on the top of the engine display.

The TAT value that shows is from the left ADIRU. When the left ADIRU TAT is invalid, the right ADIRU TAT value shows.

TAT goes out of view when the data from both ADIRUs is invalid.

6 EFIS Control Panels

Barometric correction adjusts the barometric altitude value that shows on the altimeter indication.

The barometric correction controls are on the EFIS control panels.

The controls select and set barometric correction reference, values, and displays.

Barometric correction shows on the PFD below the altitude tape.

7 DEU 1 And DEU 2

Barometric correction comes from the EFIS Control Panel through the DEUs.

8 VMO MMO

There are two mach airspeed warning test switches. They are momentary push switches.

When you push the test switch, a ground discrete goes to the ADIRU an activates the Clacker from the Aural warning Module.

9 ADIRU's

The ADR processor calculates Altitudes, Airspeeds, Mach Numbers, Temperatures and Pressure values and supplies these datas to these Systems:

- A/T (computer)
- DEU's
- FCC's
- FDAU
- ATC's
- FSEU (**F**lap/**S**lat **E**lectronics **U**nit)
- EGPWC
- SMYD's
- CPC's
- WXR
- FMC's.

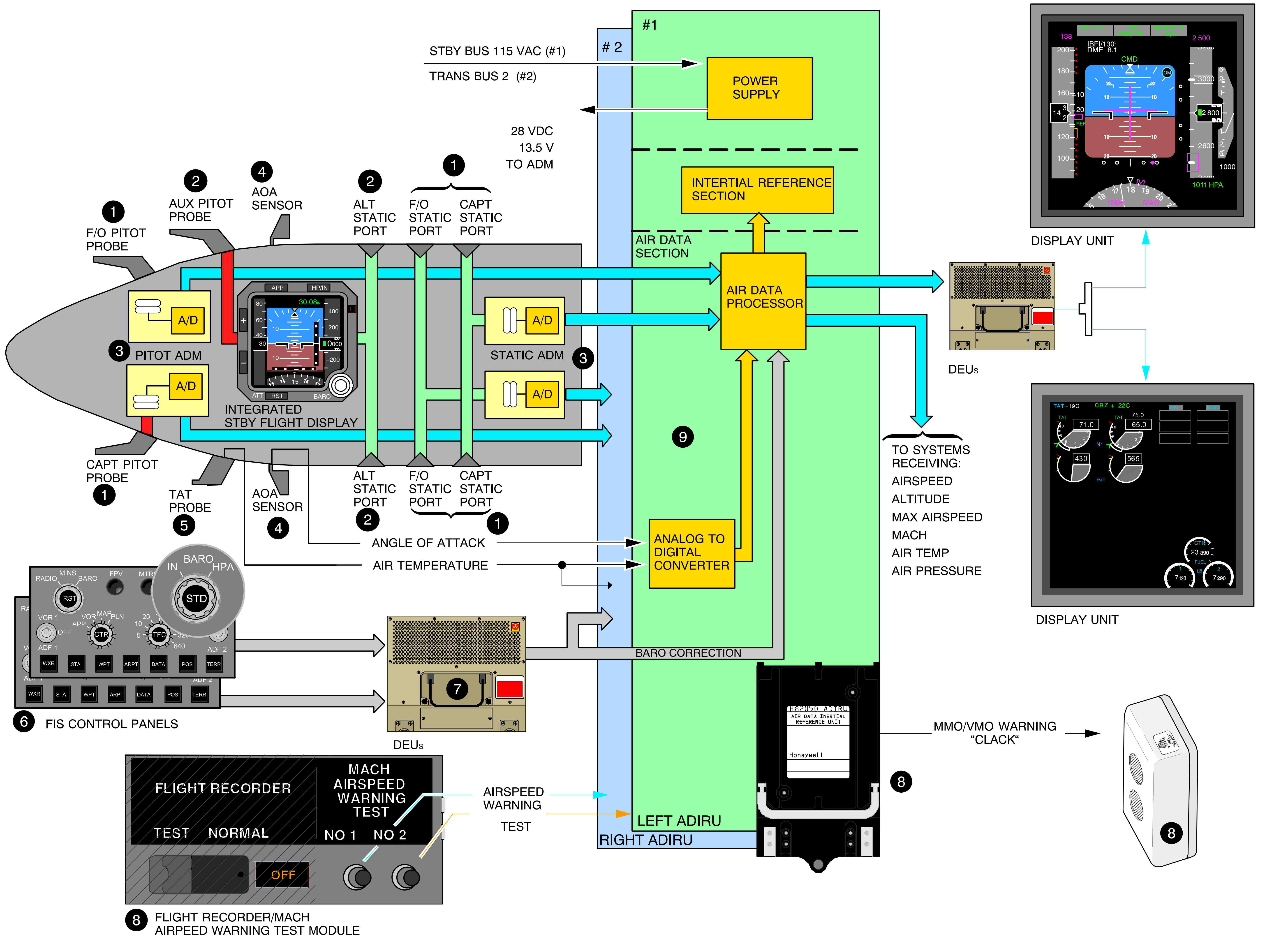


Figure 64 Air Data System Introduction

Reference to Figure 65 ADIRS Operation

34-20 ADIRS-IR GENERAL THEORY

GENERAL

The inertial reference function of the ADIRU supplies heading and attitude information.

Each ADIRU uses three accelerometers and three laser gyros to calculate IR (**I**nertial **R**eference) data. You must enter present position data for the ADIRU during alignment. The ADIRU calculates present position latitude but it cannot calculate present position longitude. The ADIRU compares your latitude entry to its calculated value to make sure its calculation of latitude is correct.

1 ISDU

The ISDU supplies both ADIRUs with test discrete, heading data, and present position data. The ADIRUs supply IR data and fault data to the ISDU.

2 MSU

The MSU supplies mode discrete to the ADIRUs. The ADIRUs supply align and fail discrete to the MSU. The MSU also receives an ON DC discrete from the ADIRUs.

The ON DC discrete goes through the IRS master caution unit.

3 CDU

You can use the FMC CDU to enter present position data.

When both ADIRUs are in alignment mode, you only need to enter the data one time. The data goes to both ADIRUs. The ADIRUs use the last data entry that you make. Push the INIT/REF key on the CDU and then LAST POS, REF AIRPORT or CDU keyboard.

4 FMC's

IRS data for position determining, test and initial present position information goes to the ADIRUs from the FMCS.

5 ADIRU

The ISDU or the FMC supplies initial position data to the IR processor. The mode of operation comes from the MSU. The gyros and accelerometers supply movement data to the IR processor.

6 IRS Transfer Switch

The IRS transfer switch is a three position switch.

The BOTH ON L and BOTH ON R switch positions tell the components to use only left IR data or only right IR data.

7 CDS

The CDS shows NCD during alignment. When the ADIRU alignment is complete and the ADIRU is in the NAV mode, the PFD and ND show ADIRU IR Data. Air data from the ADIRU is not affected by the IR mode of operation.

8 RMI

The RMI receives digital heading data from the ADIRUs. The RMI uses the heading data from the left ADIRU with the IRS transfer switch in the normal or both on left position. Move the switch to the both on right position to use heading data from the right ADIRU.

9 IRS Master Caution Unit

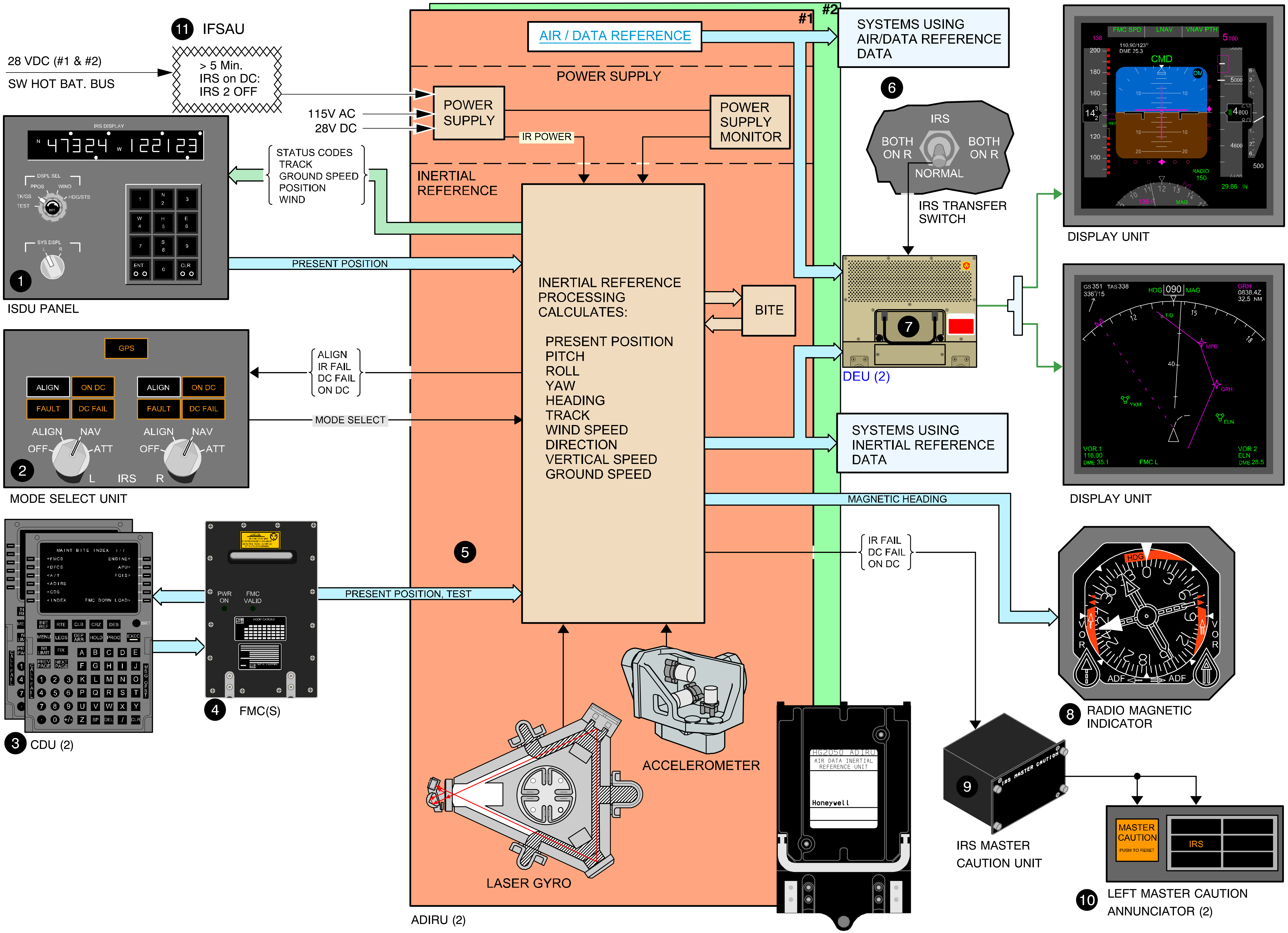
The IRS master caution unit receives fail and ON DC discrete from the ADIRUs.
The IRS master caution unit supplies discrete outputs to the MSU and to the master caution lights and annunciators.

10 Master Caution Annunciator

Shows Master CAUTION and IRS six pack light when IRS master caution unit sends a discrete signal.

11 IFSAU

If AC power for IRS fails. the DC power supplies IRS. After 5 minutes with IRS 2 on DC, the system will be switched off automatically. This feature allows the airplane battery to drain at a slower rate.
The IFSAU supplies power to the crew call horn when the ADIRUs operate with dc power on the ground.


11 IFSAU
28 VDC (#1 & #2)
SW HOT BAT. BUS
> 5 Min.
IRS on DC:
IRS 2 OFF
115V AC
28V DC
POWER SUPPLY
IR POWER
POWER SUPPLY MONITOR
POWER SUPPLY
AIR / DATA REFERENCE
#1
#2
SYSTEMS USING AIR/DATA REFERENCE DATA
INERTIAL REFERENCE
STATUS CODES
TRACK
GROUND SPEED
POSITION
WIND
IRS DISPLAY
DSPL SEL
PPOS
WIND
TK/GS
HDG/STS
TEST
SYS DSPL
ENT
CLR
1 ISDU PANEL
PRESENT POSITION
INERTIAL REFERENCE PROCESSING CALCULATES:
PRESENT POSITION
PITCH
ROLL
YAW
HEADING
TRACK
WIND SPEED
DIRECTION
VERTICAL SPEED
GROUND SPEED
BITE
6
IRS
BOTH ON R
NORMAL
BOTH ON R
IRS TRANSFER SWITCH
7
DEU (2)
DISPLAY UNIT
CMD
DISPLAY UNIT
GPS
ALIGN
ON DC
FAULT
DC FAIL
ALIGN
NAV
OFF
ATT
L
IRS
R
2 MODE SELECT UNIT
ALIGN
IR FAIL
DC FAIL
ON DC
MODE SELECT
SYSTEMS USING INERTIAL REFERENCE DATA
MAGNETIC HEADING
IR FAIL
DC FAIL
ON DC
5
PRESENT POSITION, TEST
PWR ON
FMC VALID
4 FMC(S)
3 CDU (2)
ACCELEROMETER
LASER GYRO
ADIRU (2)
HG2050 ADIRU
AIR DATA INERTIAL REFERENCE UNIT
Honeywell
9 IRS MASTER CAUTION UNIT
IRS MASTER CAUTION
8 RADIO MAGNETIC INDICATOR
HDG
ADF
VOR
MASTER CAUTION
PUSH TO RESET
IRS
10 LEFT MASTER CAUTION ANNUNCIATOR (2)

34-00 RADIO NAVIGATION GENERAL

1 ILS

The MMR contains the ILS and the GPS functions. The ILS function provides lateral and vertical position data necessary to put the airplane on the runway direction for approach. The system uses signals from a glideslope ground station and a localizer ground station. The glideslope ground station transmits signals to give the airplane a descent path to the touchdown point on the runway. The localizer ground station transmits signals to give the airplane lateral guidance to the runway centerline.

2 Loc Antenna Switch

Switches between upper localizer antenna and lower radome antenna.

3 ILS/VOR Antennas

There are two localizer antennas, one in the vertical fin which is also used as a dual vor antenna and one under the radome which is only for localizer. The only glide slope antenna is located under the radome.

4 VOR System

The VOR system is a navigation aid that gives magnetic bearing data from a VOR ground station to the airplane. The VOR ground stations transmit signals that give magnetic radial information from 000 degrees to 359 degrees.

5 Marker Beacon System

The marker beacon system supplies visual and aural indications when the airplane flies over the marker beacon transmitters. The marker beacon function only operates in the VOR/MB receiver 1 position.

6 Marker Beacon Antenna

The marker beacon antenna receives the marker beacon signals. The marker beacon antenna is on the bottom of the fuselage.

7 DME

The DME system supplies slant range distance measurement between the airplane and the DME ground station. The DME system supplies station audio and identifier signals to the interphone speakers and headsets.

8 DME Antennas

The DME antennas transmit and receive DME signals. The antennas transmit signals to the ground stations. They receive the reply signals from the DME ground station and send them to the interrogator.

9 ADF System

The ADF system is a navigation aid. The ADF receiver uses AM signals from ground stations to calculate the bearing to the ADF station from the airplane longitudinal axis. The ADF system also receives standard AM radio broadcasts.

10 ADF Antennas

The ADF antenna assembly contains the loop antennas and the sense antenna.
The antenna assembly also contains signal amplifiers for the loop and the sense antenna. The loop antennas supply direction data and the sense antenna supplies station audio.

11 ADF Contol Panel

The ADF control panel sends tune frequency inputs to the ADF receiver. The ADF control panel sends a data word that contains the ADF mode or ANT mode selection. The ADF control panel sets a bit that enables ADF receiver BFO (**B**eat **F**requency **O**scillator) operation when you turn on the tone selector.

12 GPS MMR

The GPS uses navigation satellites to supply airplane position to airplane systems and to the flight crew. There are two GPS systems. The MMRs calculate the airplane position and accurate time. This data goes to the FMCS and the IRS master caution unit. The FMCS uses GPS to calculate the airplane position.The IRS master caution unit gets GPS fail data .

13 GPS Antenna

The GPS antennas receive L-band frequency signals (1575.42 MHz) and sends them to the MMRs . Each antenna contains an integrated preamplifier to increase the signal level to the MMR.

14 CDS/RMI/ISFD

Via DEUs all systems send indication information to the PFDs and navigation displays. VOR and ADF informations are also indicated on the RMI. ILS Infos are shown on the ISFD or STBY Horizon too.

15 EFIS Control Panel

With the EFIS Control Panel, display formats are selected to show the navigation informations.

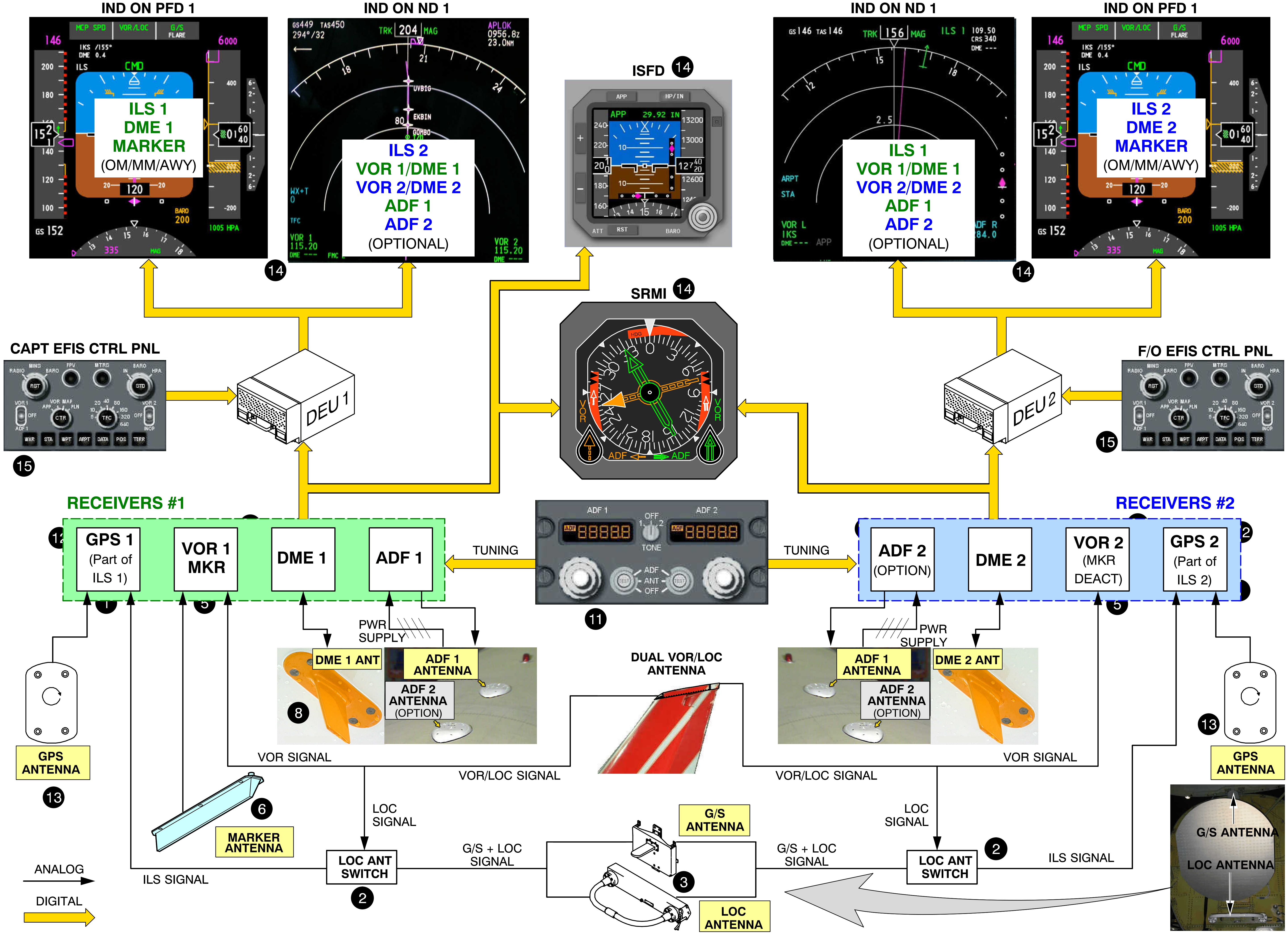


Figure 66 Radio Navigation System Schematic (1 of 2)

34-00 RADIO NAVIGATION

1 Radio Altimeter System

The RA (**R**adio **A**ltimeter) system measures the vertical distance from the airplane to the ground. The radio altitude shows in the flight compartment. The system has a range of -20 to 2500 feet. The flight crew and other airplane systems use the altitude during low altitude flight, approach, and landing. The radio altimeter system has two receiver/ transmitters. Each receiver/transmitter has a transmit and a receive antenna.

2 RA Antennas

The transmit antenna sends radio frequency CRF) signals to the ground. The receive antenna sends reflected RF signals to the receiver circuits of the RA receiver/transmitter.

3 ATC

The ATC ground stations interrogate the airborne ATC system. The ATC transponder replies to the interrogations in the form of coded information that the ground station uses.

The ATC transponder also replies to mode S interrogations from the TCAS of other airplanes. When a ground station or a TCAS computer from another airplane interrogates the ATC system, the transponder transmits a pulse coded reply signal. The reply signal identifies and shows the altitude of the airplane.

4 ATC Antennas

The two antennas transmit signals from the ATs transponder and send receive signals to the ATC transponder.

5 ATC Coax Switches

When you select ATC transponder 1 on the control panel, the ATC coax switches do not energize and the antennas connect to ATC transponder 1.

When you select ATC transponder 2 you energize the coax switches which connects the top and bottom antennas to ATC transponder 2.

6 ATC/TCAS Control Panel

The dual ATC/TCAS control panel controls the ATC transponder and the TCAS computer.

7 TCAS

The TCAS helps the flight crew and air traffic control maintain safe air traffic separation. TCAS is an airborne system. TCAS uses signals from an ATC mode S transponder to track other airplanes.
TCAS also communicates with other airplanes that have TCAS to agree on the flight movement to prevent a collision.
TCAS supplies a traffic display and visual and aural vertical commands to the flight crew.

8 TCAS Antennas

There are two TCAS directional antennas. The TCAS directional antennas receive traffic airplane reply signals. They also transmit the TCAS interrogation signals.

9 WX Radar

The WXR system supplies visual indications as weather and land contours.
The WXR system transmits RF (**R**adio **F**requency) pulses in a 180 degree area forward of the airplane path. Rain or terrain contours reflect the pulses back to the airplane. The WXR returns show in four different colours on the NDs. Colours of the indications give the crew infos about the intensity of the returns.

10 WX - Radar Control Panel

The WXR control panel has functions as, Mode selection, Tilt control and Gain control.

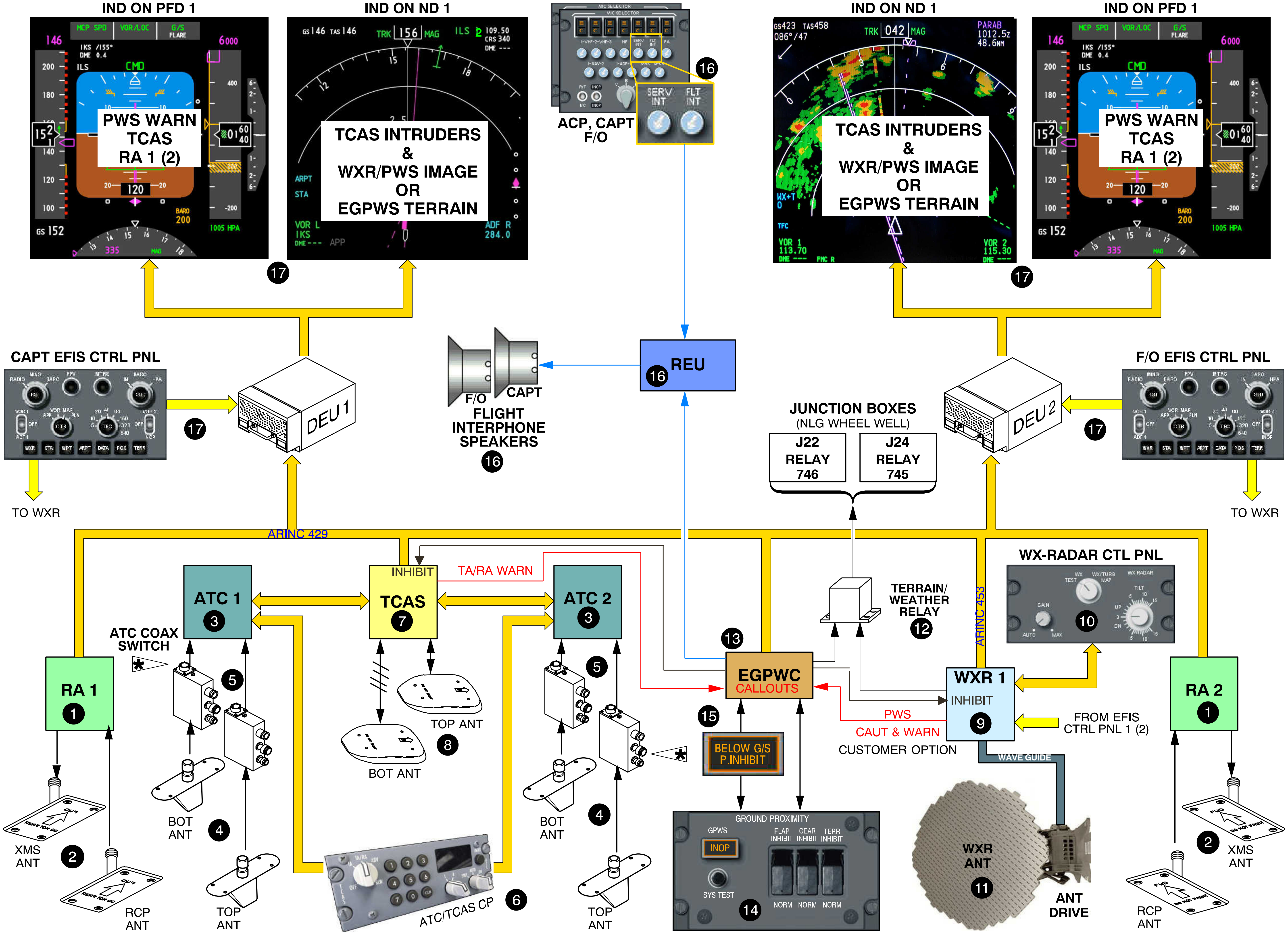
11 WXR Antenna

The WXR antenna sends the RF pulses and receives the RF returns.The R/T gets ADIRU pitch and roll data for antenna stabilization.

12 Terrain WXR Relay

The terrain select discrete can be manually initiated by the TERR switch on the EFIS control panel.

Terrain also shows automatically on the navigation display in case of EGPWS terrain cautions or warnings.


IND ON PFD 1
PWS WARN
TCAS
RA 1 (2)
IND ON ND 1
TCAS INTRUDERS
&
WXR/PWS IMAGE
OR
EGPWS TERRAIN
ACP, CAPT
F/O
SERV INT
FLT INT
16
17
CAPT EFIS CTRL PNL
TO WXR
DEU 1
F/O
CAPT
FLIGHT
INTERPHONE
SPEAKERS
REU
JUNCTION BOXES
(NLG WHEEL WELL)
J22
RELAY
746
J24
RELAY
745
DEU 2
F/O EFIS CTRL PNL
ARINC 429
INHIBIT
TA/RA WARN
ATC 1
3
TCAS
7
ATC 2
ATC COAX
SWITCH
5
TERRAIN/
WEATHER
RELAY
12
WX-RADAR CTL PNL
10
ARINC 453
RA 1
1
EGPWC
CALLOUTS
13
WXR 1
INHIBIT
9
RA 2
TOP ANT
8
BOT ANT
15
BELOW G/S
P.INHIBIT
PWS
CAUT & WARN
CUSTOMER OPTION
FROM EFIS
CTRL PNL 1 (2)
WAVE GUIDE
XMS
ANT
2
BOT
ANT
4
RCP
ANT
TOP
ANT
ATC/TCAS CP
6
GROUND PROXIMITY
GPWS
INOP
FLAP INHIBIT
GEAR INHIBIT
TERR INHIBIT
SYS TEST
NORM
14
WXR
ANT
11
ANT
DRIVE

13 **EGPWS**

The purpose of the GPWS is to alert the flight crew of an unsafe condition when near the terrain.

The GPWS also alerts the flight crew for to early descent on approach or to terrain threats ahead of the airplane. It also supplies a warning for windshear conditions and radio-altitude voice call-outs.

The main component of the GPWS is the GPWC It uses inputs from other systems to calculate unsafe conditions and gives the applicable alert or warning.

14 **EGPWS Warning Module**

The GPW module has an amber GPWS INOP light, Test switch, Flap inhibit switch, Gear inhibit switch and Terrain inhibit switch, to suppress Warnings in unusual Approach conditions.

15 **Below G/S Switch/Light**

Warns the crew about a too low approach and lets the crew inhibit the below glide slope alert.

16 **Aural System**

Warnings from the GPWC are amplified by the REU before they are put out via flight/service interphone and cockpit speakers.

17 **CDS**

Shows different status messages and warnings as „no fly areas“ and windshear warnings on PFD. TCAS, terrain or weather images are shown on the NAV displays.

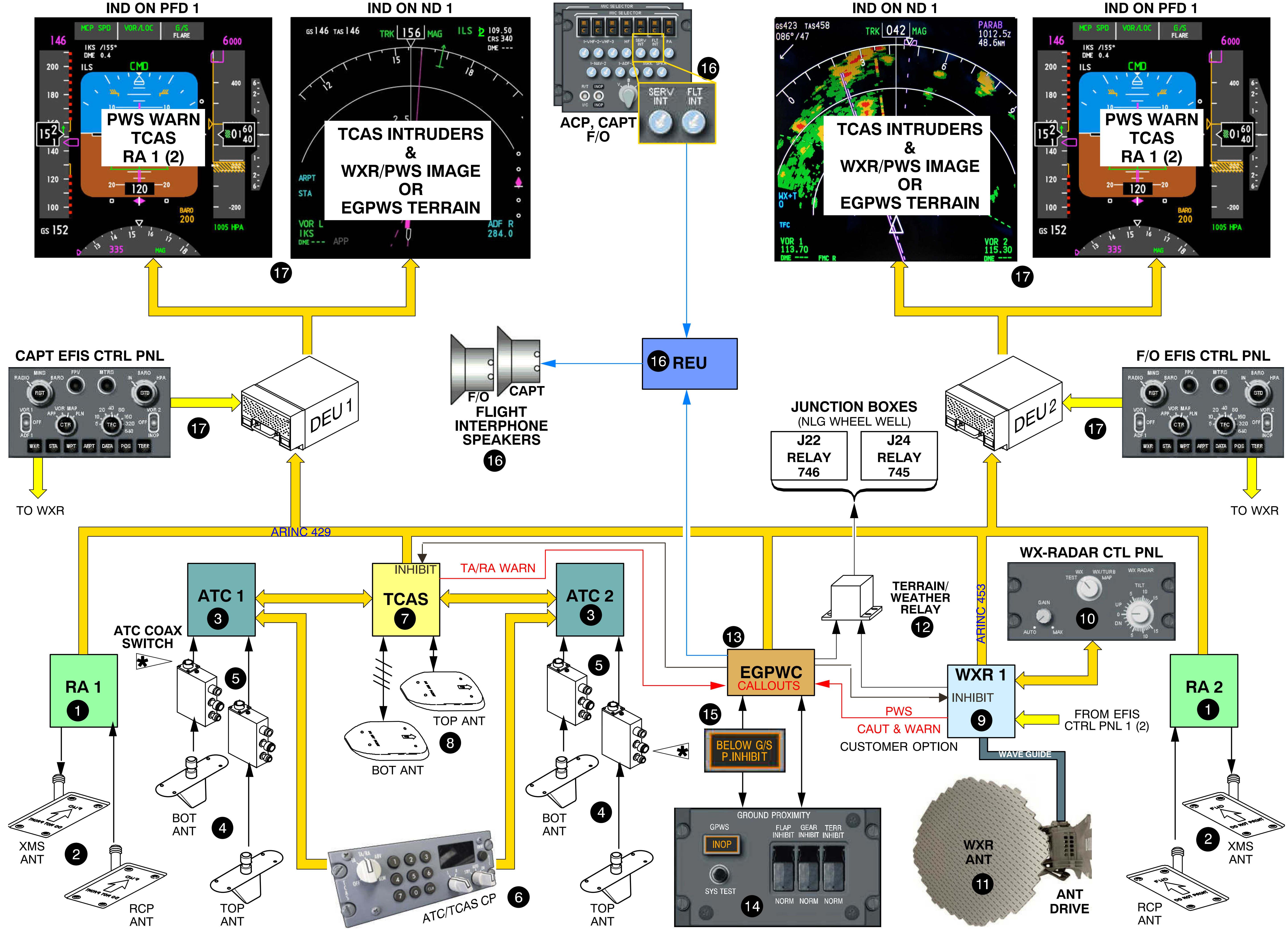


Figure 68 Radio Navigation Schematic cont. (2 of 2)

34-11 STANDBY AIR DATA INSTRUMENTS

1 Stby Altimeter/Airspeed Indicator

The standby altimeter/airspeed indicator is two flight instruments in one component.
One instrument is a pneumatic altimeter. It gets static air pressure from the alternate static ports and shows barometric altitude.
The other instrument is a pneumatic airspeed indicator. This indicator gets pitot air pressure from the auxiliary pitot probe and static air pressure from the alternate static ports to show the indicated air speed.
The standby altimeter/airspeed indicator shows air data information such as barometric altitude and indicated airspeed.
A vibrator is on the instrument frame to reduce friction errors in the mechanical linkage and to improve indicator response.

2 Stby Att. Indicator

The standby attitude reference system is an alternate source of airplane pitch and roll attitude information. The standby attitude reference system can also show ILS (**I**nstrument **L**anding **S**ystem) localizer and glideslope deviation. ILS data is from MMR (**M**ulti **M**ode **R**eceiver) 1.

The failure flags on the standby attitude indicator tell the flight crew if there is
an ILS or indicator failure.

The standby attitude indicator uses a gyro stabilized attitude ball to show airplane attitude. The gyro starts to operate when you apply power. The gyro normally aligns to vertical at a rate of three degrees per minute. You can pull the cage knob to align the gyro to vertical in a few seconds. There are no special tests for the standby attitude reference system.

3 MMR

When you select the APP mode and the ILS data is correct, the localizer and glideslope deviation pointers show ILS deviation.

4 RMI

The radio magnetic indicator is a standby instrument. Its purpose is to show
relative bearing to VOR and ADF stations. It also shows airplane magnetic heading. The RMI (Radio Magnetic Indicator) is a standby instrument. It shows heading and bearing information. Controls and Indicators The RMI has two controls. They are the ADF/VOR 1, and ADF/VOR 2 bearing pointer selectors. Turn the selector to select ADF or VOR bearing inputs to control the position of bearing pointer 1 or 2. The RMI has these indicators, Lubber line; a fixed heading reference, Compass card; shows ADIRS heading with reference to the lubber line And Bearing pointers (2); shows ADF or VOR bearing relative to the compass card.

5 Stby Magnetic Compass

The standby magnetic compass is a backup magnetic heading reference. The standby magnetic compass has a circular heading indicator card. The card floats in a case filled with liquid. The liquid does not permit the card to move quickly.

There are two magnets in the standby magnetic compass. The magnets are parallel to each other, and they are in the horizontal plane. The magnets align the compass with the magnetic flux lines of the earth.

The standby magnetic compass has N-S (north-south) and E-W (east-west) compensation screws. These screws change the position of the magnets.

Use the compensation screws to correct for magnetic deviation. Use only non magnetic tools to turn the compensation screws. There is a compass correction card near the compass. Use this card to write small errors that the compensation screws cannot remove.

6 ISFD

The standby attitude reference system is a color liquid crystal display (LCD) and consists of an integrated standby flight display (ISFD) and an ISFD dedicated battery system. If there is not sufficient power on the battery bus the battery in the battery/charger supplies power to the ISFD with battery switch in on.

The ISFD shows this standby data:

- Attitude
- Airspeed
- Altitude
- Heading
- Glide Slope and Localizer

It has an internal Gyro which provides attitude indications.

The ISFD is a pneumatic altimeter and airspeed indicator. The Sensors are the Auxilliary Pitot and static ports.

The air data inertial reference system (ADIRS) provides heading to the ISFD from the left air data inertial reference unit (ADIRU).

The standby attitude reference system also shows information from the instrument landing system (ILS) or (GLS) from the MMR 1.
To start the BITE, simultaneously push and hold the APP and the HP/IN switches for at least two seconds. After two seconds, the TESTS and OTHER DATA page shows.

- Display Test
- Functional Test
- LRU Ident
- Engineering Data

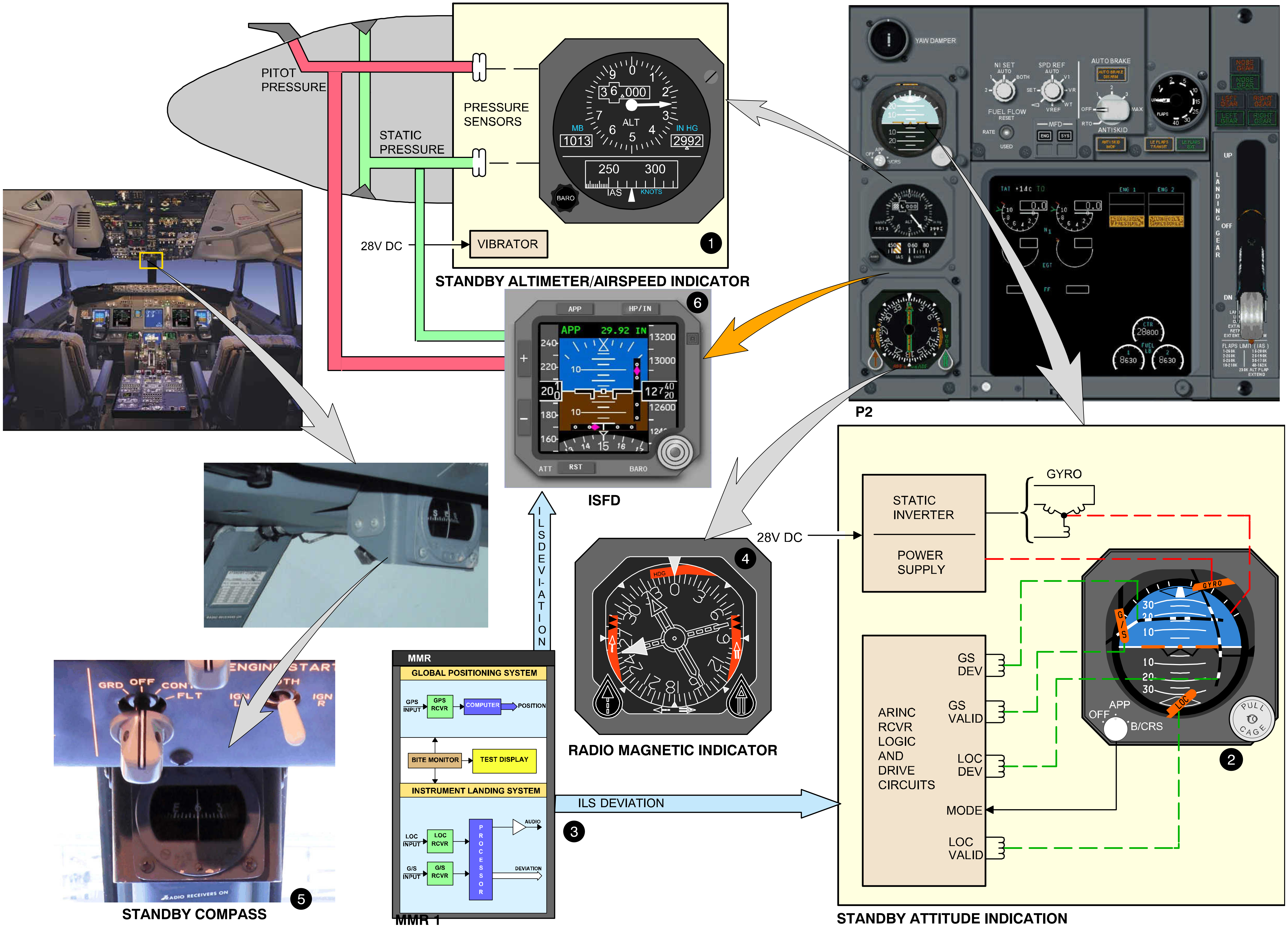


Figure 69 Standby Air Data/Attitude System

Reference to Figure 70 FMCS-Schematic

34-61 FMCS-SYSTEM

GENERAL

The flight crew uses the FMCS (**F**light **M**anagement **C**omputer **S**ystem) to enter route and vertical performance flight plan data for a flight.

With the flight plan and inputs from the airplane sensors, the FMCS does these functions:

- Navigation
- Performance
- Guidance.

The main component of the flight management computer system is the FMC. The FMC receives the data and does the navigation and performance calculations.

The flight crew uses the CDUs (also called MCDUs) to put data into the FMC. The FMC input and output data format is ARINC 429 digital data and analog discretes. Some FMC data goes directly to the user systems. Other output data goes to the user systems through the transfer relays.

1 FMC

A navigation data base is in the FMC memory. It includes the navigation data for the area of operation. The pilot can use the navigation data base to set the entire flight plan before a flight.

The FMC calculates the airplane position during the flight.The FMC compares the calculated position with the set position. If there is a difference, it shows on the common display system.

A performance data base in the FMC contains data to model the airplane and the engines. The CDS (**C**ommon **D**isplay **S**ystem) shows target speeds and altitudes.

Guidance :The FMC sends commands to the DFCS (**D**igital **F**light **C**ontrol **S**ystem) and the autothrottle (A/T). The DFCS and the A/T use these signals to control the airplane in the lateral (LNAV) and vertical (VNAV) modes of flight.

2 Data Loader

The ADL (**A**irborne **D**ata **L**oader) connects to the FMCs through the data loader control panel. The data loader digital input and output connects to FMC 1 and FMC 2 through the data loader control panel.

The control panel must be set to the FMC position to transfer data to the FMCs.
The new data base(s) may then be crossloaded between the FMCs

3 CDU

The flight crew uses the CDU (**C**ontrol **D**isplay **U**nit), (also called the MCDU) to put in flight data and to select displays and modes of operation.

They also use the CDU to start ADIRU alignment.

You use the CDU to test the FMCS and other systems. There are two CDUs in the airplane. They are functionally and physically interchangeable.

4 ACARS

The FMC/ACARS interface allows the receipt (uplink) and transmission (downlink) of FMC data from or to the customers ground computers via the ACARS management unit.

ACARS data for FMC 1 and FMC 2 goes through FMCS Transfer Relay 1.

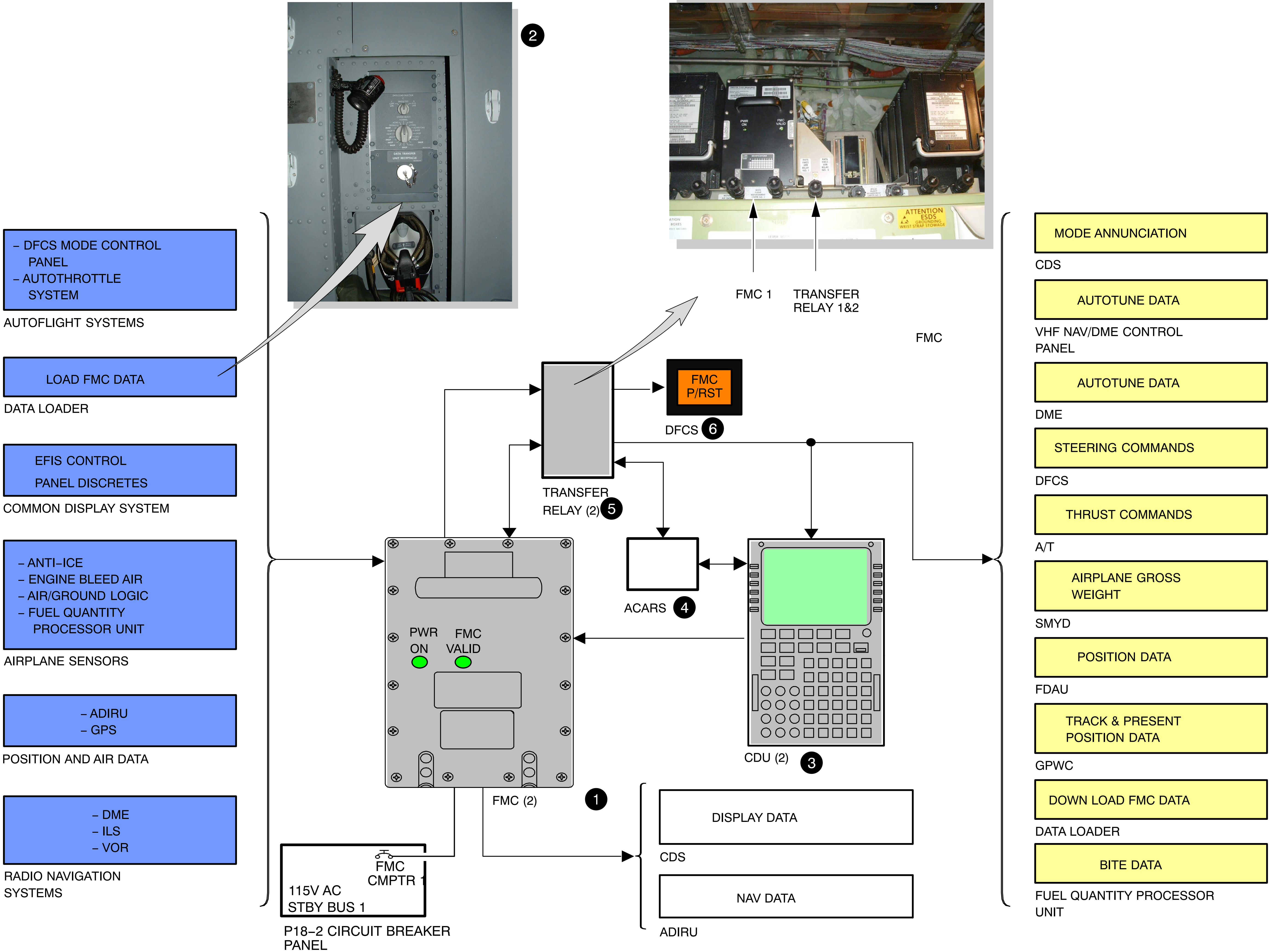
ACARS data for the CDUs is direct and does not go through the transfer relays. Uplink and downlink data is sent through the transfer relay 1.

5 Transfer Relays

The transfer relays are mechanically latched to the FMC 1 position. The open input to the DEUs and DFDAU cause these systems to select FMC 1 for data. The open input to the source select bits of FMC 1 tell the FMC that there is only one FMC installed. The FMC source select switch controls the dc power to the transfer relays.

6 ASAs

The FMC light indicates problems with FMC.


– DFCS MODE CONTROL PANEL
– AUTOTHROTTLE SYSTEM
AUTOFLIGHT SYSTEMS
LOAD FMC DATA
DATA LOADER
EFIS CONTROL
PANEL DISCRETES
COMMON DISPLAY SYSTEM
– ANTI–ICE
– ENGINE BLEED AIR
– AIR/GROUND LOGIC
– FUEL QUANTITY PROCESSOR UNIT
AIRPLANE SENSORS
– ADIRU
– GPS
POSITION AND AIR DATA
– DME
– ILS
– VOR
RADIO NAVIGATION SYSTEMS
2
FMC 1
TRANSFER RELAY 1&2
FMC
FMC P/RST
DFCS 6
TRANSFER RELAY (2) 5
ACARS 4
PWR ON
FMC VALID
CDU (2) 3
FMC (2) 1
FMC CMPTR 1
115V AC STBY BUS 1
P18–2 CIRCUIT BREAKER PANEL
DISPLAY DATA
CDS
NAV DATA
ADIRU
MODE ANNUNCIATION
CDS
AUTOTUNE DATA
VHF NAV/DME CONTROL PANEL
AUTOTUNE DATA
DME
STEERING COMMANDS
DFCS
THRUST COMMANDS
A/T
AIRPLANE GROSS WEIGHT
SMYD
POSITION DATA
FDAU
TRACK & PRESENT POSITION DATA
GPWC
DOWN LOAD FMC DATA
DATA LOADER
BITE DATA
FUEL QUANTITY PROCESSOR UNIT

34-61 FLIGHT MANAGEMENT COMPUTER SYSTEM

GENERAL

The flight crew uses the FMCS (**F**light **M**anagement **C**omputer **S**ystem) to enter route and vertical performance flight plan data for a flight.

With the flight plan and inputs from the airplane sensors, the FMCS does these functions:

1 Guidance

The FMC sends commands to the DFCS (**D**igital **F**light **C**ontrol **S**ystem) and the A/T (**A**uto**t**hrottle).
The DFCS and the A/T use these signals to control the airplane in the lateral (LNAV) and vertical (VNAV) modes of flight.

2 Performance

A performance data base in the FMC contains data to model the airplane and the engines.

The flight crew puts this data in the FMC:

- Airplane gross weight
- Cruise altitude
- Cost index.

The FMC uses the data to calculate these functions:

- Economy speeds
- Best flight altitude
- Top of descent point
- End of descent point

3 Navigation

A navigation data base is in the FMC memory. The pilot can use the navigation data base to set the entire flight plan before a flight.

The FMC calculates the airplane position during the flight. It uses the inertial reference function and the radio navigation aids. The FMC compares the calculated position with the set position. If there is a difference, it shows on the common display system.

4 CDS

The CDS (**C**ommon **D**isplay **S**ystem) shows target speeds, altitudes and Navigation Informations.

5 CDU

The flight crew uses the CDUs (also called MCDUs) to put data into the FMC.
The FMC input and output data format is ARINC 429 digital data and analog discretes. You use the FMCS CDU to select and control BITE.

6 FMC

The main component of the FMCS (**F**light **M**anagement **C**omputer **S**ystem) is the FMC.

The FMC receives the data and does the navigation, guidance and performance calculations. Some FMC data goes directly to the user systems. Other output data goes to the user systems through the transfer relays.

It is also used for Maintenance Bite Test Functions, for example:

- FMCS
- DFCS
- A/T
- CDS
- APU and Engine Control Unit

These program pins customize the FMCS to your airline's configuration.

A dip switch assembly sets the options:

- Airplane model 737-700
- Thrust rating 22,000
- Performance code 1
- ACARS installed
- Selected course radial inhibit on EFIS
- Degrees C default
- Flight number entry
- Runway position update on TO/GA
- Weight in kilograms
- JAA flight rules.

7 Airplane Systems

These example LRUs supply data to the FMCS:

- VOR/MB
- DME
- MMR
- Electronic clock.

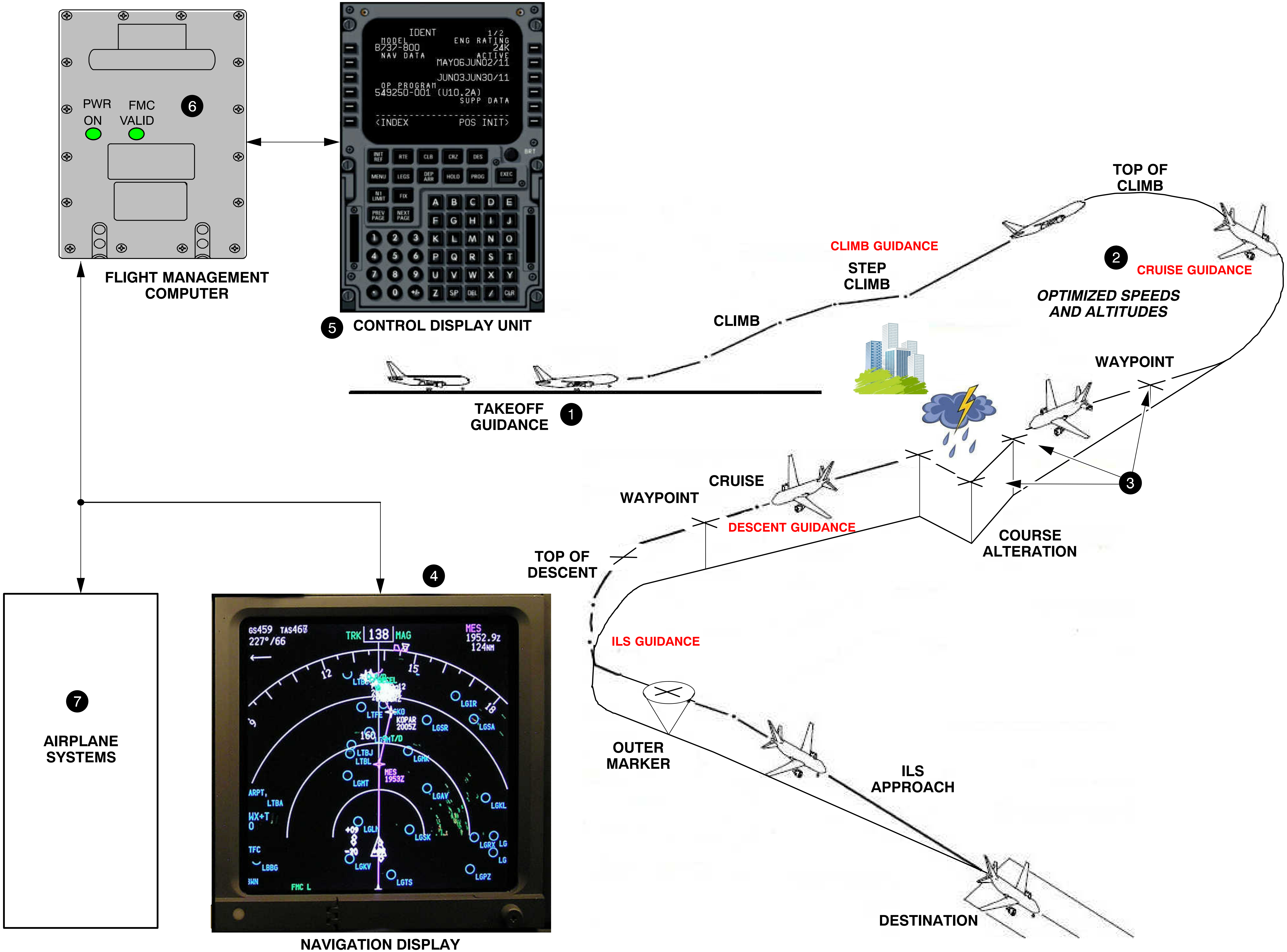


Figure 71 FMCS Introduction

Reference to Figure 72 FMCS Operation

1 Transfer Relay (DUAL FMC)

The transfer relays are Ledex type relays. They mechanically latch to the position you select. The FMCS source select switch controls the FMCS transfer relays. The FMC source select switch controls the dc power to the transfer relays. Contacts on the transfer relays tell these LRUs the position of the transfer relays:

- DEU (1&2)
- FDAU
- FMC (1&2).

2 Program Pin

A dip switch assembly sets these options:

- Airplane model 737-700
- Thrust rating 22,000
- Performance code 1
- ACARS installed
- Selected course radial inhibit on EFIS
- Degrees C default
- Flight number entry
- Runway position update on TO/GA
- Weight in kilograms
- JAA flight rules.

3 FMCS-Digital Output

The FMC data on bus 08 and 09, goes directly to the DEUs. The other user systems get this FMC data through the transfer relays. The DEUs get EFIS display data directly from both FMCs. The DEUs use contacts on the FMCS transfer relays to know the position of the transfer relays. The DEUs use the position information to know which FMC to use for data.

The bus 02 has this data:

- Distance to go (waypoint)
- Groundspeed
- VOR/DME frequencies
- Set latitude
- Set longitude
- Set magnetic heading
- Origin/destination
- Destination runway
- Destination estimated time of arrival (ETA)
- Gross weight
- Total fuel
- FMC target altitude/airspeed
- FMC target mach number
- Horizontal command
- Vertical speed command
- Waypoint bearing
- Cross--track deviation
- Vertical deviation
- Magnetic track angle
  Drift angle
- GMT/ Date
- SAT (**S**tatic **A**ir **T**emperature)
- Selected temperature
- Flight number
- Minimum airspeed
- N1 limits
- BITE test word

FMC discretes

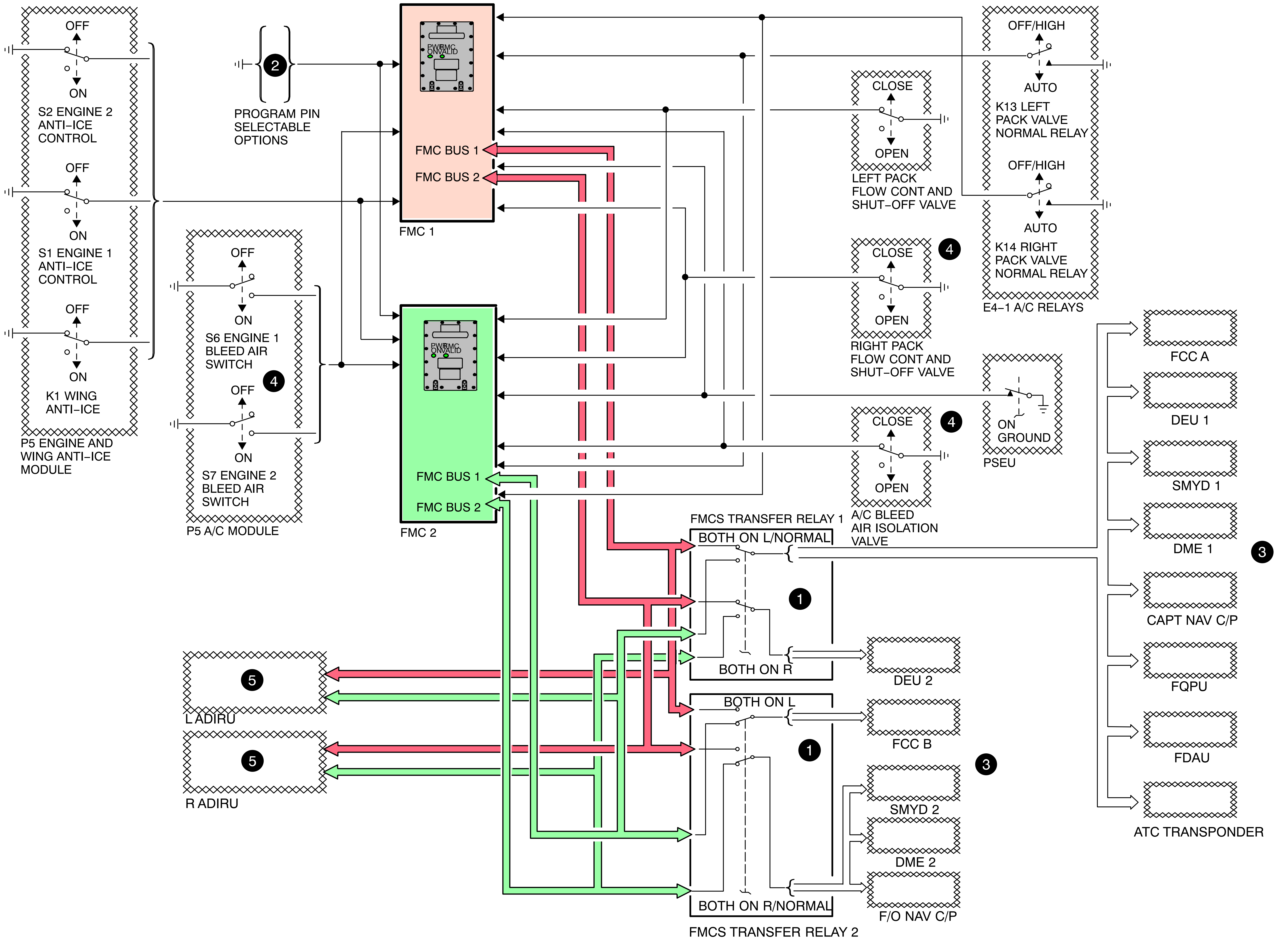
- IAS/mach
- Engine out engaged
- Landing flaps selected
- Manual N1 select
- Level decel
- Autothrottle to idle arm
- Autothrottle to arm
- FMC vertical speed
- N1 limit mode
- Speed on elevator
- Reduced thrust (derate)
- Level change request
- VNAV valid

4 Analog Discretes

Inputs from switches and valves give engine bleed air data to the FMCS. The FMCS uses these signals to calculate the performance values. The program pin selectable options customize the FMCS to your airline' s configuration.

5 ADIRU

The ADIRUs send data to the FMCS.
The FMC sees the inertial data and the air data as two different sensors.
The FMCs use the same air data source as the DFCS.


OFF
ON
S2 ENGINE 2 ANTI-ICE CONTROL
OFF
ON
S1 ENGINE 1 ANTI-ICE CONTROL
OFF
ON
K1 WING ANTI-ICE
P5 ENGINE AND WING ANTI-ICE MODULE
2
PROGRAM PIN SELECTABLE OPTIONS
OFF
ON
S6 ENGINE 1 BLEED AIR SWITCH
4
OFF
ON
S7 ENGINE 2 BLEED AIR SWITCH
P5 A/C MODULE
FMC BUS 1
FMC BUS 2
FMC 1
FMC BUS 1
FMC BUS 2
FMC 2
CLOSE
OPEN
LEFT PACK FLOW CONT AND SHUT-OFF VALVE
CLOSE
4
OPEN
RIGHT PACK FLOW CONT AND SHUT-OFF VALVE
CLOSE
4
OPEN
A/C BLEED AIR ISOLATION VALVE
OFF/HIGH
AUTO
K13 LEFT PACK VALVE NORMAL RELAY
OFF/HIGH
AUTO
K14 RIGHT PACK VALVE NORMAL RELAY
E4-1 A/C RELAYS
ON GROUND
PSEU
FMCS TRANSFER RELAY 1
BOTH ON L/NORMAL
1
BOTH ON R
BOTH ON L
1
BOTH ON R/NORMAL
FMCS TRANSFER RELAY 2
5
L ADIRU
5
R ADIRU
DEU 2
FCC B
3
SMYD 2
DME 2
F/O NAV C/P
FCC A
DEU 1
SMYD 1
DME 1
3
CAPT NAV C/P
FQPU
FDAU
ATC TRANSPONDER

Reference to Figure 73 FMCS System Summary

34-61 FMC SYSTEM

1 VOR/MB

The left and right VOR receivers supply the bearing and the frequency of the VOR stations that are manual tuned.

2 DME

The Slant range distance and the station frequency come from the left and right DME interrogators.

3 ILS/MMR

The localizer deviation and the station frequency come from multimode receivers 1 and 2.

4 Electronic Clock

The captain's electronic clock supplies GMT to FMC 1. The first officers electronic clock supplies GMT to FMC 2.

5 ADIRU

The ADIRUs send data to the FMCS. The FMC sees the inertial data and the air data as two different sensors. The FMCs use the same air data source as the DFCS.

6 DEU/CDS/APU/EEC

The DEU (**D**isplay **E**lectronic **U**nits) send EFIS control panel discrete and CDS BITE data to the FMCS.

The DEUs, also send APU, ECU and engine EEC BITE data on the same bus. There is no direct BITE interface between the FMCS and the APU and EEC. The DEUs are a buffer between the APU, EEC and the FMCS

7 A/T

The autothrottle computer sends A/T BITE words.

8 DFCS

The DFCS sends data to the MCP (**M**ode **C**ontrol **P**anel) The MCP sends it to the FMCS.

The MCP sends this data:

- LNAV mode status
- VNAV mode status
- Trailing edge flap position
- DFCS BITE words.

9 FQPU

The FQPU **(F**uel **Q**uantity **P**rocessor **U**nit) calculates total fuel weight and sends it to the FMCS. Fuel quantity BITE words also come from the FQPU.

The selected FMC sends a BITE test word to the processor unit.

10 Data Loader Control Panel

Upload/Download Software, Databases and Operation Programs

11 Discrete Inputs

Inputs from switches and valves give engine bleed air data to the FMCS. The FMCS uses these signals to calculate the performance values. The program pin selectable options customize the FMCS to your airline's configuration.

12 FCC

LNAV/VNAV outputs for DFCS guidance.

13 GPWC

The selected FMC sends track and path angle plus wind direction.

14 FDAU

The selected FMC sends present position (latitude and longitude) plus wind speed and direction.

The FMCS sends navigation data to the FDAU.

15 SMYD

The FMCS sends gross weight data to the stall management function in the SMYDs.

16 ACARS

Uplinks/Downlinks for example:

- Fuel Init
- Flight Plan a.s.o.

17 ASA

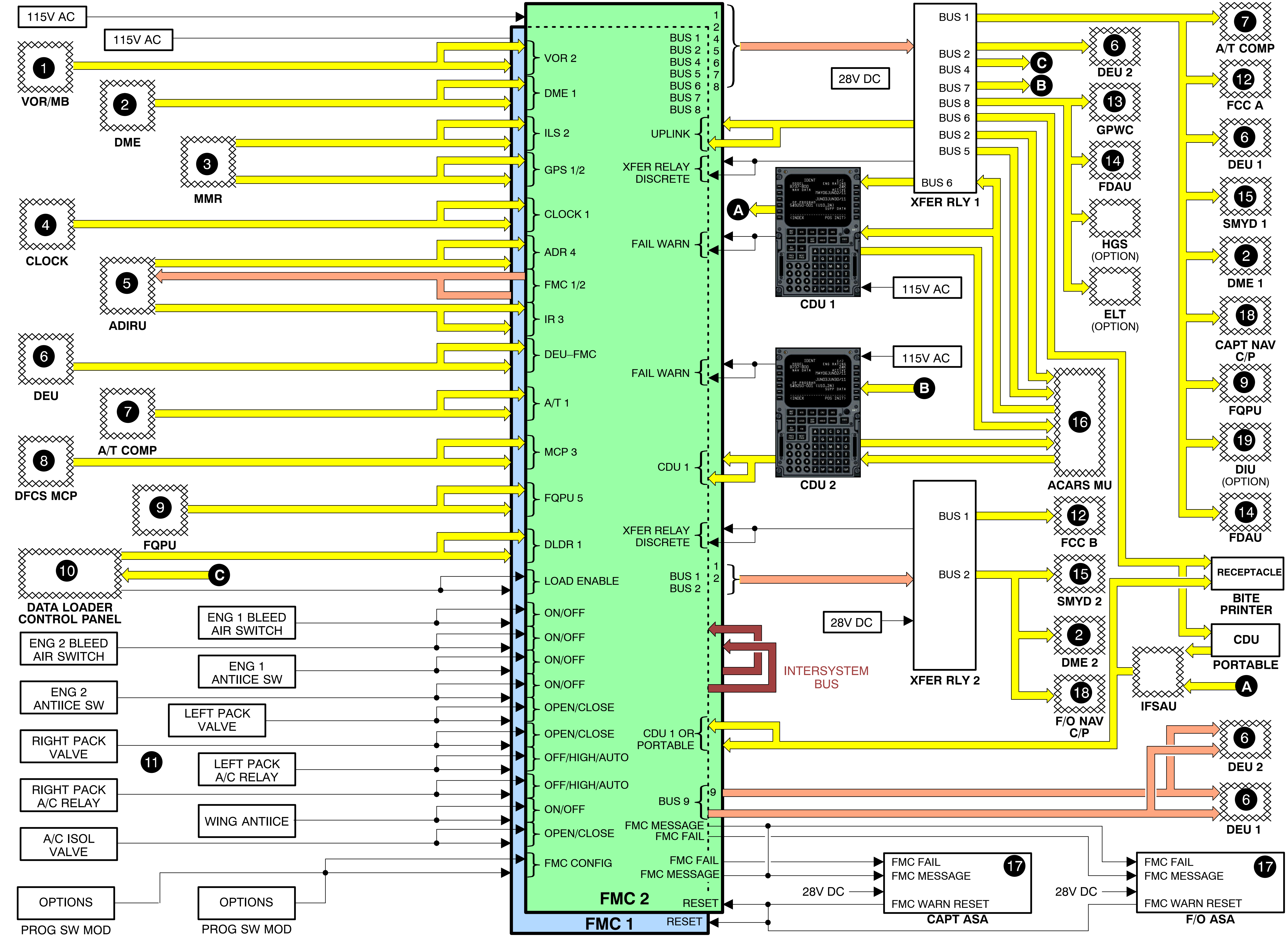
The FMC warning light iluminates in amber when an FMC has an alert message or when an FMC fails.

18 NAV CP

The FMCs send autotuned navigation frequencies to the NAV control panels for the DMEs.

19 DIU

The Digital Interface Unit receives flight data from the FMC and provides this to the airshow for PAX information.


115V AC
115V AC
VOR/MB
DME
MMR
CLOCK
ADIRU
DEU
A/T COMP
DFCS MCP
FQPU
DATA LOADER CONTROL PANEL
ENG 1 BLEED AIR SWITCH
ENG 2 BLEED AIR SWITCH
ENG 1 ANTIICE SW
ENG 2 ANTIICE SW
LEFT PACK VALVE
RIGHT PACK VALVE
LEFT PACK A/C RELAY
RIGHT PACK A/C RELAY
WING ANTIICE
A/C ISOL VALVE
OPTIONS
PROG SW MOD
OPTIONS
PROG SW MOD
VOR 2
DME 1
ILS 2
GPS 1/2
CLOCK 1
ADR 4
FMC 1/2
IR 3
DEU–FMC
A/T 1
MCP 3
FQPU 5
DLDR 1
LOAD ENABLE
ON/OFF
ON/OFF
ON/OFF
ON/OFF
OPEN/CLOSE
OPEN/CLOSE
OFF/HIGH/AUTO
OFF/HIGH/AUTO
ON/OFF
OPEN/CLOSE
FMC CONFIG
BUS 1
BUS 2
BUS 4
BUS 5
BUS 6
BUS 7
BUS 8
UPLINK
XFER RELAY DISCRETE
FAIL WARN
FAIL WARN
CDU 1
XFER RELAY DISCRETE
BUS 1
BUS 2
CDU 1 OR PORTABLE
BUS 9
FMC MESSAGE
FMC FAIL
FMC FAIL
FMC MESSAGE
RESET
FMC 2
RESET
FMC 1
28V DC
XFER RLY 1
CDU 1
CDU 2
115V AC
115V AC
XFER RLY 2
28V DC
INTERSYSTEM BUS
A/T COMP
DEU 2
FCC A
GPWC
DEU 1
FDAU
SMYD 1
HGS (OPTION)
DME 1
ELT (OPTION)
CAPT NAV C/P
FQPU
ACARS MU
DIU (OPTION)
FDAU
FCC B
RECEPTACLE
BITE PRINTER
SMYD 2
DME 2
CDU PORTABLE
F/O NAV C/P
IFSAU
DEU 2
DEU 1
FMC FAIL
FMC MESSAGE
FMC WARN RESET
CAPT ASA
28V DC
FMC FAIL
FMC MESSAGE
FMC WARN RESET
F/O ASA
28V DC

Reference to Figure 74 WTRIS General Schematic

ATA 27 FLIGHT CONTROLS

27-24 WHEEL TO RUDDER INTERCONNECT SYSTEM

GENERAL

The WTRIS (**W**heel **T**o **R**udder **I**nterconnect **S**ystem) assists manual reversion turns when both hydraulic systems A and B are OFF and the standby system is ON.

The WTRIS commands a small amount of rudder movement as a function of the capt's control wheel aileron input. After you turn on the standby yaw damper, and after a two-second delay, the yaw damper engage light will go off to show these systems are operating.

1 SMYD 2

SMYD 2 sends commands to the standby rudder PCU to assist turns during flight control manual reversion and for standby yaw damping/turn coordination.

The LVDT on the standby rudder PCU sends rudder position data to SMYD 2 about rudder movement. The trailing edge flaps up limit switches send flaps up/not up data to SMYD 2 to limit rudder movement when the flaps are up.

Power goes from the DC power and dim control to the yaw damper disengage light. During standby hydraulic operations, when you turn ON the yaw damper engage switch, an engage signal goes through SMYD 2 to the yaw damper solenoid valve on the standby rudder PCU to engage the yaw damper.
SMYD 2 commands rudder movement using the standby EHSV in the STBY Rudder PCU. The flight control panel switches for system A and B must be in the OFF or STBY RUD position to enable SMYD 2 for WTRIS and standby yaw damping. If there is a system fault, SMYD 2 will remove power from the engage solenoid valve on the standby rudder PCU to shut off hydraulic fluid to the EHSV.

2 Control Wheel Position Sensor

The captain CW (**C**ontrol **W**heel) position sensor senses pilot aileron input and sends an analog signal to the SMYD 2 to calculate a command for left/right rudder movement for WTRIS.

3 Yaw Damper Engage Switch and Disengage Light

You engage WTRIS and standby yaw damping with the yaw damper switch on the flight control panel. The disengage warning light is above the switch.

4 Standby Rudder PCU

The standby rudder PCU is a hydraulic actuator that moves the rudder in response to pilot rudder inputs when on standby hydraulic pressure. During standby operation, SMYD 2 sends commands to the yaw damper components on the standby rudder PCU.

5 ADIRU

The ADIRUs (**A**ir **D**ata **I**nertial **R**eference **U**nits) send data to the SMYDs.
The data includes airspeed, attitude, and yaw and roll rates and accelerations.

6 FLT Control Switches

Switching both FLT CONT A and B switches to OFF sends a signal to enable SMYD 2 for WTRIS and standby yaw damping.
Place at least one of these switches to STBY RUD to provide standby hydraulic pressure to the standby rudder PCU to move the rudder.

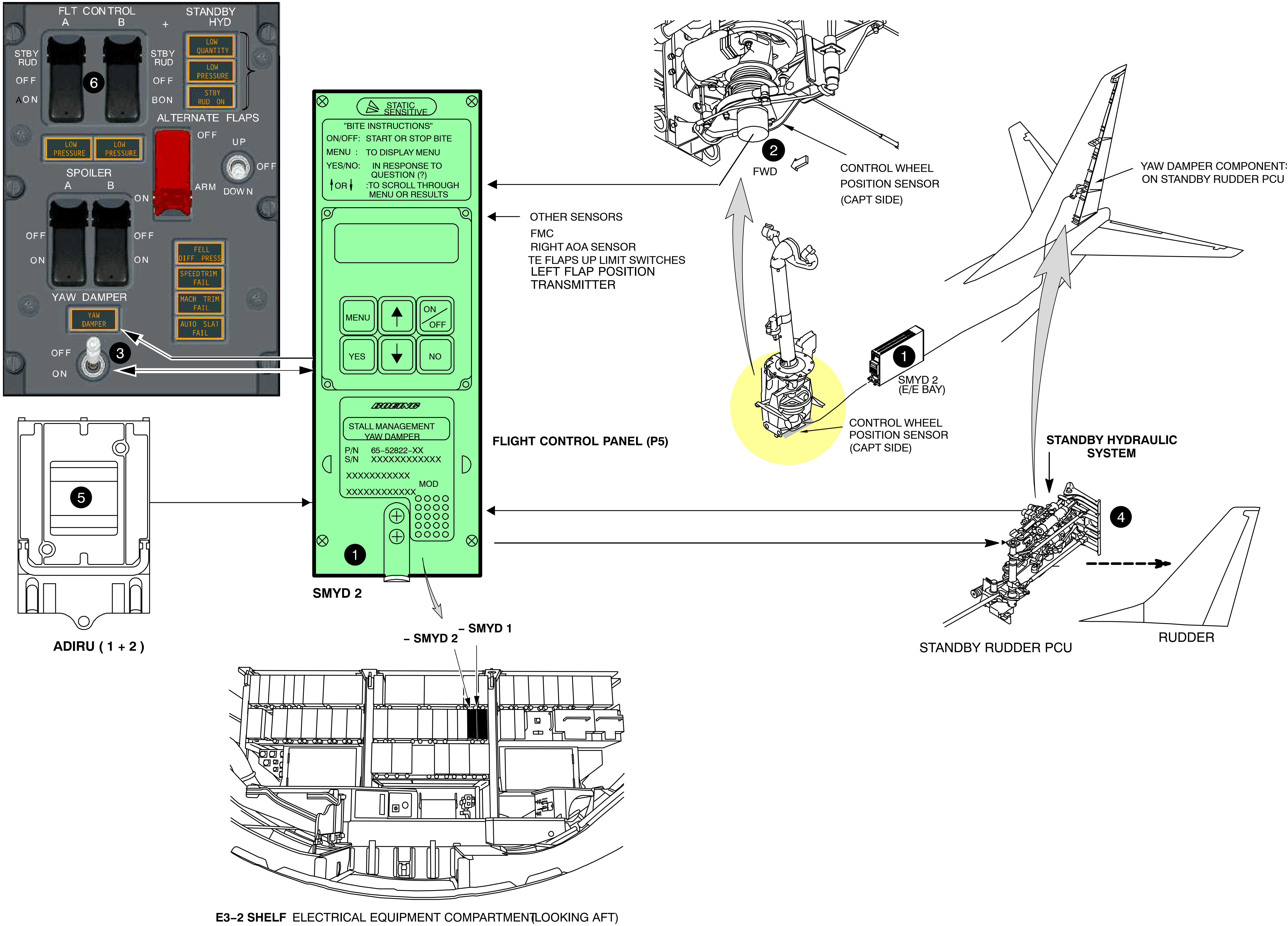


Figure 74 WTRIS General Schematic

Reference to Figure 75 Crew Oxygen System Basic Schematic

ATA 35 OXYGEN
35-10 CREW OXYGEN SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The flight crew oxygen system has a supply of high pressure gaseous oxygen and distributes and delivers it at low pressure to the crew. High pressure oxygen is kept in an oxygen cylinder assembly. The oxygen cylinder assembly includes a safety discharge device to protect against too much pressure. Oxygen cylinder pressure is reduced through a pressure regulator. Low pressure oxygen is distributed through individual control panels and mask stowage boxes.

1 Crew Oxygen Cylinder

The crew oxygen cylinder is a pressure vessel. A frangible disk in the cylinder assembly protects the bottle from overpressure. A mechanical pressure indicator on the bottle shows bottle pressure. The bottle is filled to 1850 psig at a temperature of 70F. Servicing the oxygen cylinder is by cylinder replacement.

2 Overpressure Discharge And Indication

A frangible (breakable) safety disk on the oxygen cylinder protects the cylinder from overpressure. If an overpressure condition breaks this disk, the oxygen will flow overboard. The line outlet is covered by a green plastic indication disk. The escaping oxygen blows the disk out of its seat. A missing disk indicates bottle overpressure discharge.

3 Pressure Gage

A mechanical pressure gage on the oxygen cylinder indicates the cylinder pressure. The gage shows pressure regardless of the cylinder shutoff valve position.

4 Manual Shutoff Valve

A shutoff valve on the cylinder head opens or closes the cylinder to the supply system.

5 Pressure Transducer

The pressure transducer supplies a bottle pressure signal to the flight crew oxygen pressure indicator. Power supply is from the Battery Bus.

6 Crew Oxygen Pressure Indicator

An electrically powered gage on the P5 panel shows the pressure at the cylinder outlet coupling. The indicator has internal lights and gets power from 28 VDC from the Battery Bus. The indicator reads from 0-2000 psi.

7 Pressure Regulator

A diaphragm controls a metering valve that reduces the oxygen pressure from bottle pressure to 60-85 psig.The regulator has a fail safe relief valve. This relief valve opens when downstream line pressure is more than 100 psig. The relief valve bleeds into the EE compartment.

8 System Shutoff Valve

A system shutoff valve on the P6 panel controls the flow of low pressure oxygen to the crew masks.

9 Pilot Mask Boxes

The pilot masks stow in special panel mounted boxes. The boxes include a shutoff valve. Is closed when the mask is stowed. It opens when you remove the mask.

The purpose of the oxygen mask/regulator on the masks is to provide oxygen to the flight crew when demanded in either a diluted state or 100% oxygen.

10 Observer Masks

The observer mask stowage cups do not have the box features.

The purpose of the oxygen mask/regulator on the masks is to provide oxygen to the flight crew when demanded in either a diluted state or 100% oxygen.

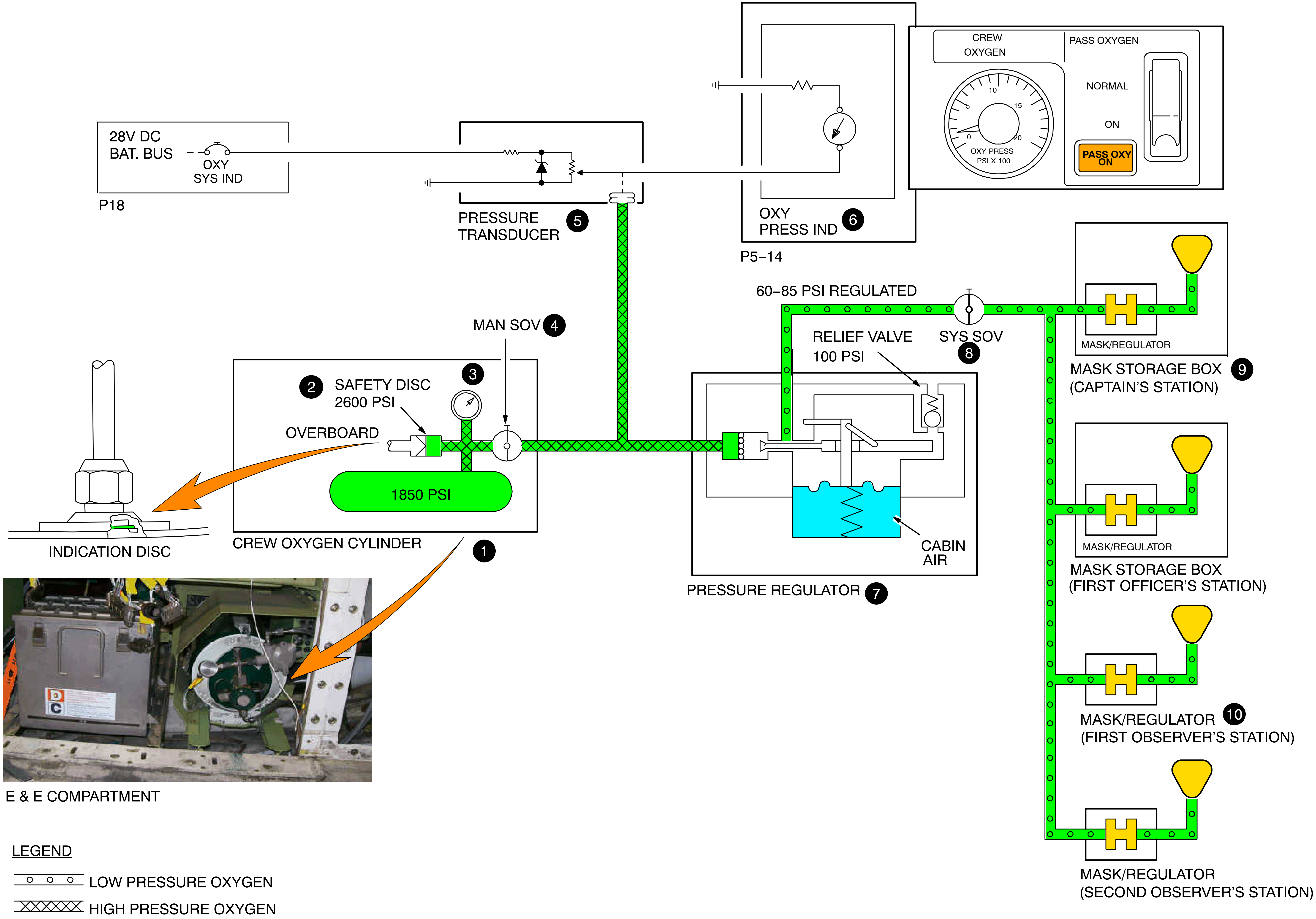


Figure 75 Crew Oxygen System Basic Schematic

Reference to Figure 76 PASSENGER OXGEN SYSTEM Basic Schematic

35-20 PASSENGER OXGEN SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The passenger oxygen system uses chemical generators to make oxygen. Oxygen from the generators flows through flexible supply hoses to the passenger oxygen masks. Passenger oxygen masks are deployed electrically one of two ways:

- Manually by the crew using a guarded toggle switch on the aft P5 panel
- Automatically by activation of an aneroid switch (cabin altitude 14000 ft.).

Passenger oxygen generation is initiated mechanically when the oxygen mask is pulled to the users face. Passenger oxygen generators, masks, firing pin mechanisms, and deployment door latch actuators are located in:

- The passenger service units (PSUs)
- The lavatory service units
- The attendant service units.

1 PASSENGER OXYGEN ON SWITCH

A guarded toggle switch for manual deployment of the passenger oxygen masks is located on the aft P5 panel.

2 ALTITUDE PRESSURE SWITCH

An aneroid switch for automatic deployment, and system electrical relays are located in the EE compartment in the J23 junction box.

3 PASSENGER OXYGEN ON LIGHT

A PASS OXY ON light on the P5 panel indicates deployment of the passenger oxygen masks.

4 PASSENGER SERVICE UNIT

Passenger oxygen masks are stowed in a compartment within the overhead passenger service unit.

5 PASSENGER OXYGEN LATCH MECHANISM

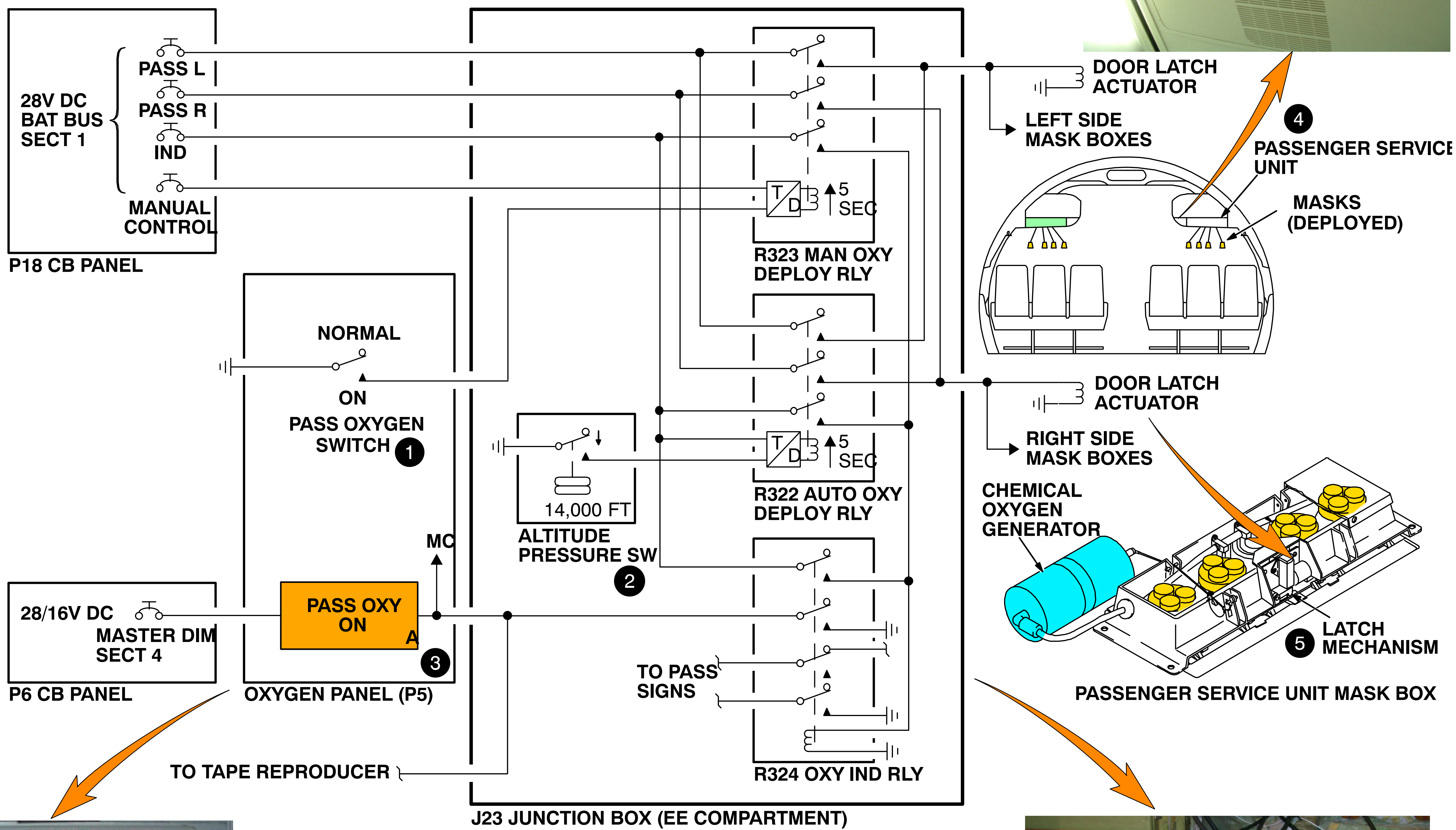
The door latch actuator has an electrically controlled solenoid supplied from the 28 VDC battery bus, which removes a pin from the striker. When the spring loaded striker releases the latch, it causes the oxygen mask box door to open.

6 J23 BOX

The oxygen release components are in the J23 box in the EE compartment. The J23 box is on the left side of the EE compartment access door.

The J23 contains these components:

- Manual oxygen deployment relay, R323
- Automatic oxygen deployment relay, R322
- Oxygen indication relay, R324
- Altitude pressure switch



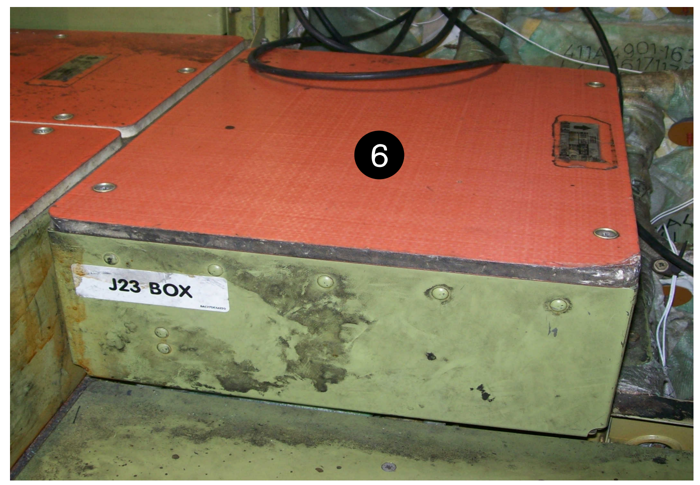


Figure 76 PASSENGER OXGEN SYSTEM Basic Schematic

Reference to Figure 77 Pneumatic Basic Schematic

ATA 36 PNEUMATIC

36-00 GENERAL

SYSTEM DESCRIPTION

The purpose of the pneumatic system is to supply bleed air from the air sources via a pneumatic manifold to user systems.

Air sources

The main air sources are:

Engine 1 and 2

- 5th stage

  The main supply of bleed air is from the 5th compressor stage of each engine, through a check valve, to the pneumatic manifold.
- 9th stage

  When 5th-stage bleed air pressure is not high enough, 9th-stage bleed air is used. Switching from 5th-stage bleed air to 9th-stage bleed air is controlled automatically by the high stage valve and regulator.

APU

- APU bleed air is primarily used for engine starting and for air conditioning pack operation on the ground. Flow of APU air into the pneumatic manifold is controlled by the APU bleed air valve. The APU can be used as an alternate bleed air source up to airplane altitudes of 17 000 ft.

Ground Cart

- Ground cart bleed air is supplied, through the ground pneumatic service connection, to the pneumatic manifold. This air is primarily used for engine starting and for air conditioning pack operation on the ground.

Pneumatic manifold

The pneumatic manifold interconnects the bleed air sources to the user systems. The pneumatic manifold system extends from the engine at one wing to the crossover duct in the air conditioning bay below the center wing section to the other engine at the opposite wing. An electrically actuated isolation valve in the crossover duct separates the left and right side system. There are two duct pressure transmitters installed in the crossover duct to monitor duct pressure on either side of the isolation valve. The pneumatic manifold contains the necessary valves to shut off bleed air at each engine if there is excessive pressure or temperature.

Air user

- Engine start system
- Air conditioning packs
- Wing anti ice
- Nose cowl anti ice
- Water tank pressurization
- Hydraulic tank pressurization

1 HIGH STAGE VALVE

The high stage valve will open whenever the 5th stage pressure is below 32 psi The high stage valve is pneumatically actuated, controlled by the regulator.

The regulator, modulate the valve's output to maintain 34 psi.

At higher engine speeds, the pressure in the 5th stage of the engine compressor becomes higher than 34 psi. When the interstage ducting pressure increases above 34 psi, the high stage valve closes. The 5th stage air supplies the engine bleed air manifold under these conditions.

2 PRESSURE REGULATOR AND SOV

The pressure regulator and shutoff valve performs three functions in the engine bleed system:

- Limits downstream pressure 45 psi.
- Limits downstream temperature to 230°C.
- Provides bleed air shutoff capability.

The PRSOV closes if:

- bleed air control switch in OFF .
- fire handle pulled.
- engine start valve in OPEN position.
- duct pressure > 220 psi.
- temperature in the pneumatic manifold > 255°C.

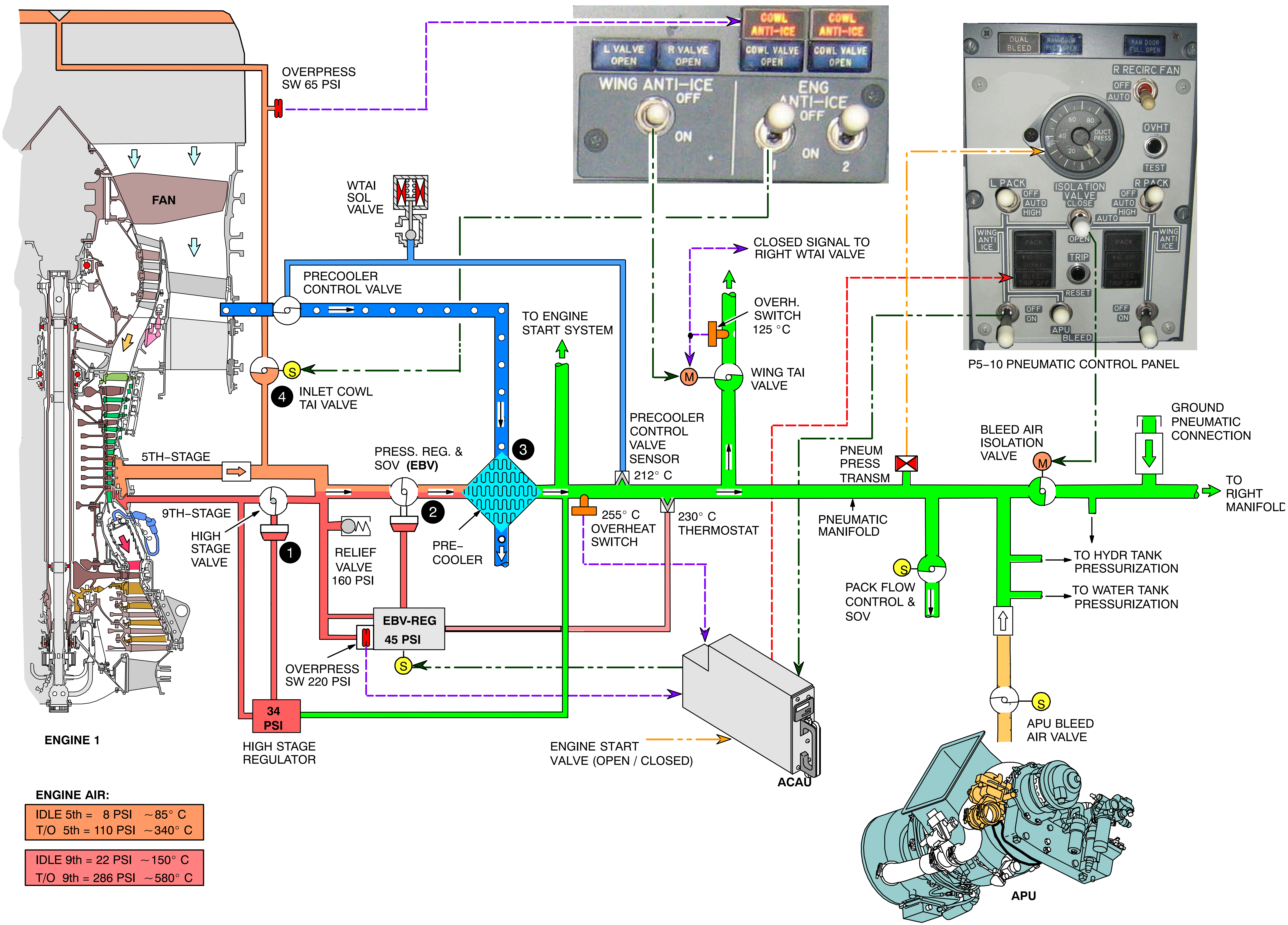
3 BLEED AIR TEMPERATURE CONTROL SYS.

Each engine bleed system contains a bleed air temperature control system. This consists of a precooler, precooler control valve and sensor. The engine bleed air temperature is automatically controlled to a preset temperature whenever the engine is operating and the Pressure Regulator and Shutoff Valve is open. The temperature is regulated to 212°C. Engine fan air is used as the heat sink for the bleed air.

4 Inlet Cowl Anti-icing System

The inlet cowl anti-icing system keeps ice from forming on the engine inlet cowl. The sytems operate in flight and on the ground. When the system is ON, the inlet cowl TAI (**T**hermal **A**nti-**I**ce) valve opens.

An inlet cowl TAI pressure switch monitors the pressure in the duct downstream of the inlet cowl anti-icing valve. It causes the COWL ANTI-ICE (P5) light to come ON if pressures in the duct are greater than 65 psi.



ENGINE AIR:

IDLE 5th =	8 PSI	~85° C
T/O 5th =	110 PSI	~340° C

IDLE 9th =	22 PSI	~150° C
T/O 9th =	286 PSI	~580° C

Figure 77 Pneumatic Basic Schematic

Reference to Figure 78 Potable Water System Basic Schematic

ATA 38 WATER AND WASTE

38-10 POTABLE WATER

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The potable water system supplies water to the lavatories and galleys.

The potable water system has these subsystems:

- Passenger water
- Water heating
- Water quantity indication.

The water heating system heats the water supplied to the lavatory hot water faucets. The water quantity indication system measures and displays the quantity of water in the potable water system.

1 Water Tank

The potable water system has one tank that holds potable water. You fill and drain the water tank at the water service panel. To fill the water tank, open the fill/overflow valve and add water through the potable water fill fitting until the water flows from the potable water drain port.

The water tank supplies water to these locations:

- Galley faucets
- Lavatory faucets
- Lavatory toilets.

2 Water Service Panel

The water service panel lets you fill the potable water system. The water service panel also lets you drain the water tank and part of the potable water system.

3 Fill/Overflow Valve

The fill/overflow valve has these functions:

- Lets water flow into the water tank from the potable water fill fitting
- Lets air out of the water tank to vent overboard as the tank fills with water
- Lets water flow overboard when water volume reaches the standpipe
- Depressurizes the water tank for system service or maintenance.

When you put the fill/overflow valve in the open position, the potable water fill line connects to the water tank fill line and the water tank overflow line connects to the potable water drain line.

4 Water Tank Drain Valve

The water tank drain valve lets water drain overboard from the water tank and the aft water distribution lines.

5 Pressurization System

The water tank pressurization system pressurizes the potable water tank. Pressure for the water tank comes from the pneumatic system or the air compressor. The pneumatic system supplies pressurized air to the water tank when the pneumatic system is on. An in-line air filter cleans the air in the pneumatic system supply line. A pressure regulator controls the pneumatic system supply line pressure to a maximum of 35 psig. The three-phase AC motor operates the air compressor to pressurize the water tank. The motor starts when the pressure limit switch senses that tank pressure is less than 30 psig. The motor stops when tank pressure is more than 40 psig.

6 Water Tank Level Sensor

The water tank level sensor sends the water quantity data to a water quantity transmitter. The water quantity transmitter sends the data to a water quantity indicator at the attendant panel.

7 Forward Lavatory Drain Valve

The forward lavatory has a separate drain valve. The forward lavatory drain valve drains water from the forward water supply lines.

8 Water Supply Shutoff Valve

The water supply shutoff valve lets you isolate the water supply to the sink or to the toilet. The water supply shutoff valve also lets you isolate the sink and the toilet at the same time.

9 Drain Masts

The drain masts let waste water from the lavatory and galley sinks flow overboard. The drain masts have internal heaters that keep the waste water from freezing.

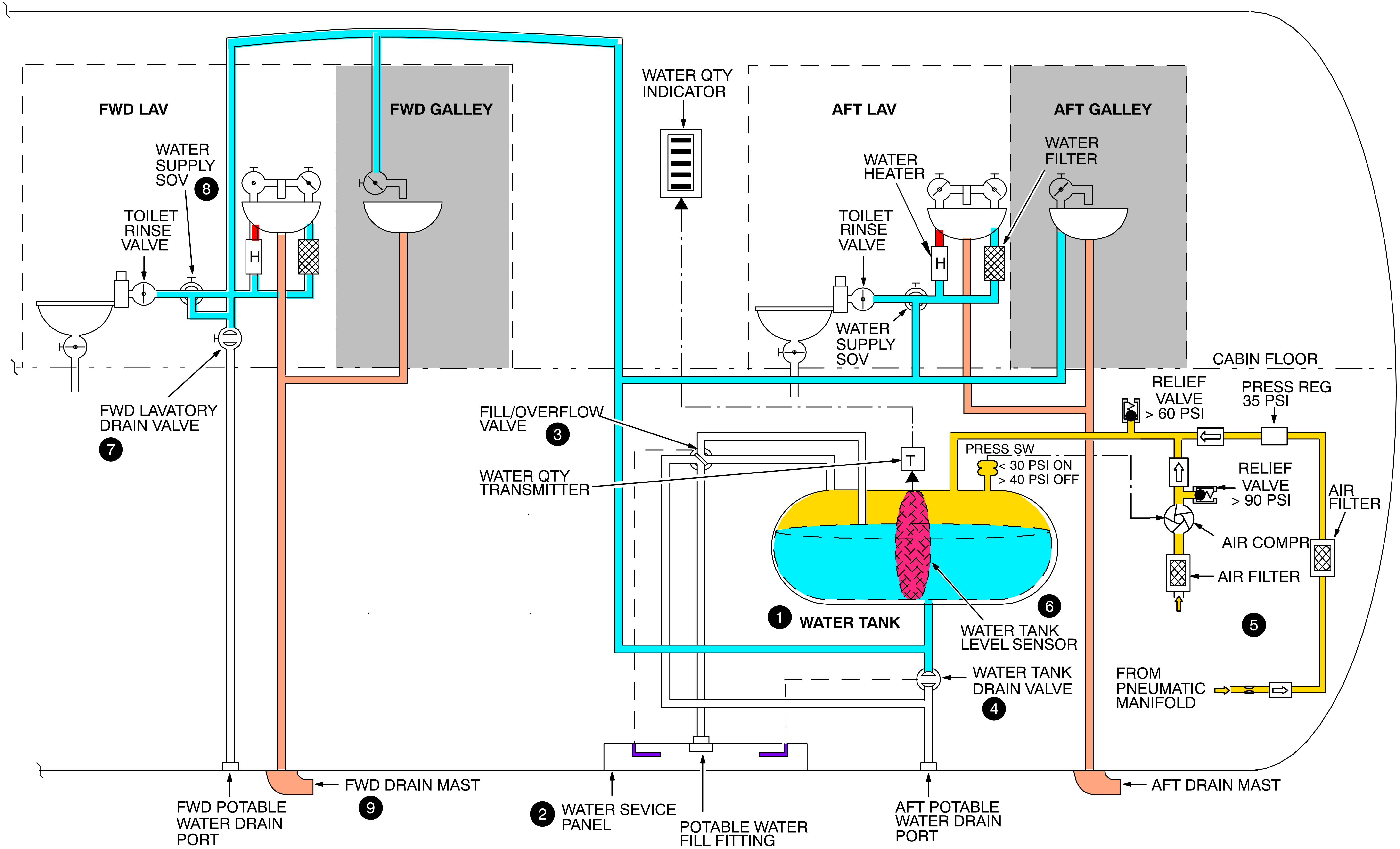


Figure 78 Potable Water System Basic Schematic

Reference to Figure 79 Vacuum Waste System Basic Schematic

38-32 VACUUM WASTE SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

The vacuum toilet collects human waste. A flush cycle puts the waste material into the vacuum waste tubing. There are two sources that cause low pressure (vacuum) in the tank:

- The vacuum blower
- Cabin-to-ambient pressure differential.

1 Waste Tank

The waste tank collects the waste from the lavatory toilets. Differential pressure causes the toilet bowl contents to flow from the toilet to the waste tank. The vacuum blower or cabin differential pressure supplies the differential pressure for the waste tank.

2 Waste Service Panel

The waste service panel lets you drain the vacuum waste system. It also lets you rinse the waste tank.

These are the components in the waste service panel:

- Waste drain valve assembly
- Waste drain ball valve control handle
- Waste tank rinse fitting assembly.

3 Waste Drain Ball Valve

The waste drain ball valve and linkage assembly control the flow of waste out of the waste tank. You pull the handle at the waste service panel to open the waste drain ball valve. The proximity switch stops the operation of the vacuum blower when the waste drain ball valve is not closed. There is a heater blanket on the waste drain ball valve.

4 Vacuum Blower

The vacuum blower removes the air from the waste tank and blows it out of the airplane. The vacuum blower operates when you push the flush switch and the airplane is below 16,000 feet.

5 Vacuum Check Valve

The vacuum check valve prevents the pull of ambient air in from the waste tank vent port by the vacuum blower.

6 Vacuum Blower Barometric Switch

The vacuum blower barometric switch opens when the altitude is above 16,000 feet. The open switch does not let the vacuum blower come on.

7 DRAIN LINE BLOCKAGE REMOVAL VALVE

The handle lets you to put the drain line blockage removal valve in one of these two positions:

- Normal
- Blockage removal.

The blockage removal position „blockage removal“ lets rinse water flow to the drain line elbow. The drain line elbow is the section of drain line between the waste drain ball valve and the waste drain valve assembly at the service panel.

8 Point Level Sensors

The point level sensors give a signal to the LCM (**L**ogic Control **M**odule) when the waste tank is full.

9 Continuous Level Sensor

The continuous level sensor measures the level of waste material in the waste tank for the waste quantity indication. The output signal goes to the LCM.

10 Logic Control Module

The LCM provides a waste tank level signal to the waste tank quantity indicator on the attendant panel. When both point level sensors send a tank full signal to the LCM, it sends a signal to the FCUs to stop the operation of the toilets.

11 Flush Control Unit

Operation of the flush switch sends a signal to the flush control unit. The FCU opens the rinse valve to supply potable water to flush the toilet bowl. After 0.7 seconds, the FCU closes the rinse valve. Each rinse cycle uses eight ounces of potable water (237ccm). The FCU then opens the flush valve for four seconds to let the toilet waste drain out of the toilet. The flush valve then closes. The anti-siphon valve prevents the vacuum waste system from siphoning water from the potable water system. The manual shutoff handle closes the flush valve.

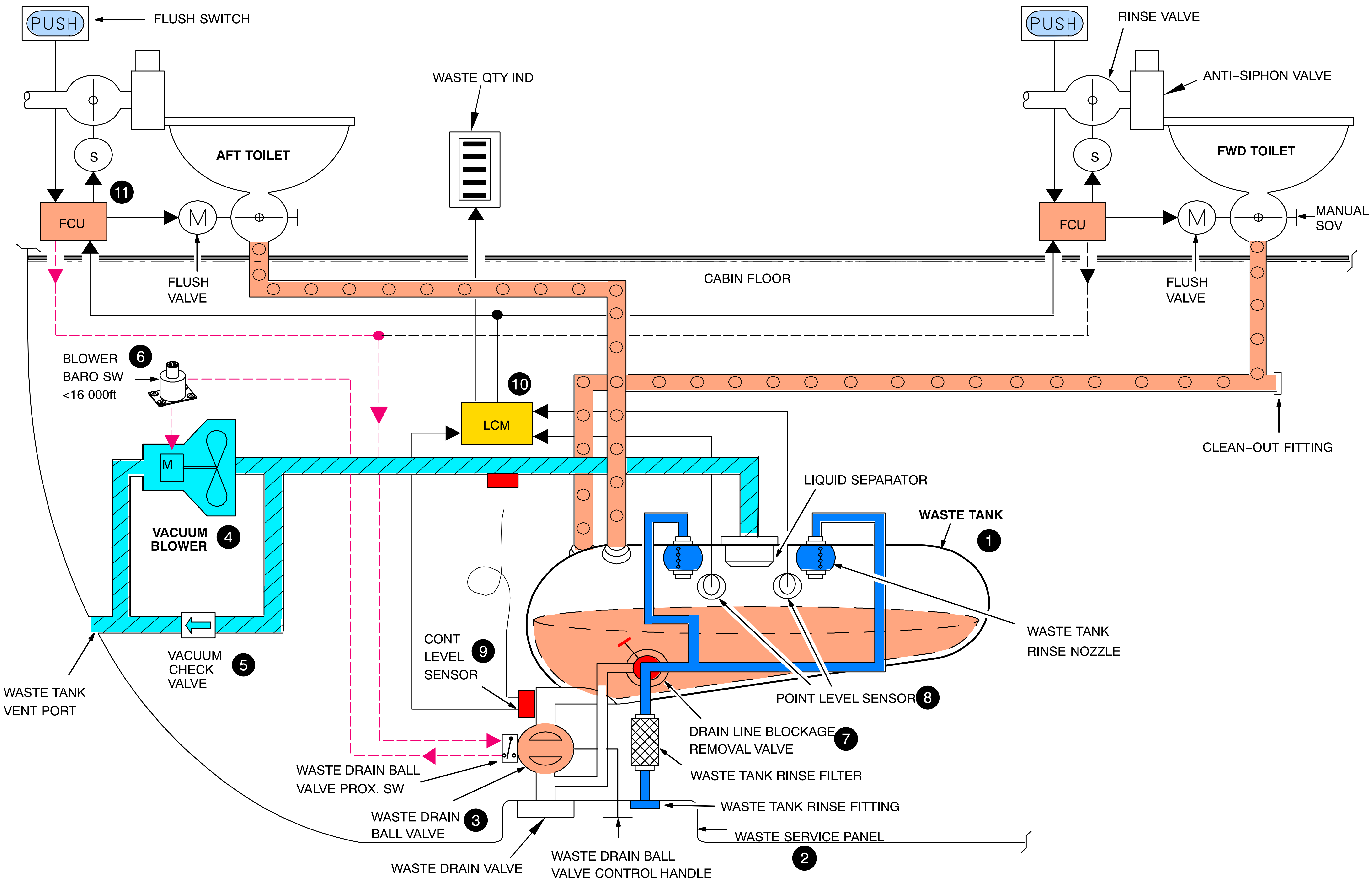


Figure 79 Vacuum Waste System Basic Schematic

Reference to Figure 80

ATA 47 INERT GAS SYSTEM

47-00 GENERAL

SYSTEM DESCRIPTION

Purpose

The Nitrogen Generation System (NGS) is an inert gas system that reduces the oxygen content of the air mixture in the center tank to a level which will not support combustion. Fresh air contains approximately 78% nitrogen and 21% oxygen. The NGS separates the nitrogen and oxygen into nitrogen-enriched air (NEA) and oxygen-enriched air (OEA). NEA increases the nitrogen content and decreases the oxygen of the air.

1 Press Sensor

The bleed pressure sensor monitors the bleed air inlet pressure. When the bleed air pressure goes above 67 psig, a signal is sent to the NGS controller to close the NGS and the over-temperature shutoff valve.

2 NGS shutoff valve

Controls the air pressure into the system.

3 Ozone converter

Changes the ozone in the air to oxygen.

4 Heat exchanger

Decreases the temperature of the air.

5 Ram air valve

The ram air valve controls the ram air to keep a constant temperature (71°C) to the air separation module (ASM).

6 Filter and filter differential pressure switch

Removes contamination from the air that can damage the NGS and fuel system components.

The differential pressure switch monitors the filter.

7 Temperature sensor

The temperature sensor monitors the air temperature going out of the thermal control unit.

8 Thermal switch

The thermal switch is a backup device to prevent an overtemperature condition in the air separation module.

9 Overtemperature shutoff valve (OTSOV)

The overtemperature shutoff valve gives backup protection for the air separation module if the controller fails. This is controlled by the thermal switch.

10 Air separation module

Removes oxygen from the air.

11 Oxygen sensor

The NGS oxygen sensor measure the oxygen content and absolute pressure from the Air Separation Module (ASM). The data gathered is then supplied to the NGS controller for system status monitoring.

12 High flow valve

The high flow valve supplies low flow volume and high flow volume, depending on flight phase, to the center tank.

13 Differential pressure sensor

A differential pressure sensor is connected to the high flow valve. It senses pressure differences between the inlet and outlet ports of the valve. The controller uses this data, altitude, and airplane systems data to set the valve position.

14 NGS Controller

The controller monitors and controls system operating temperatures and pressures.

15 Altitude Sensor

A altitude sensor sends this information to the NGS Controller to set the high flow valve position.

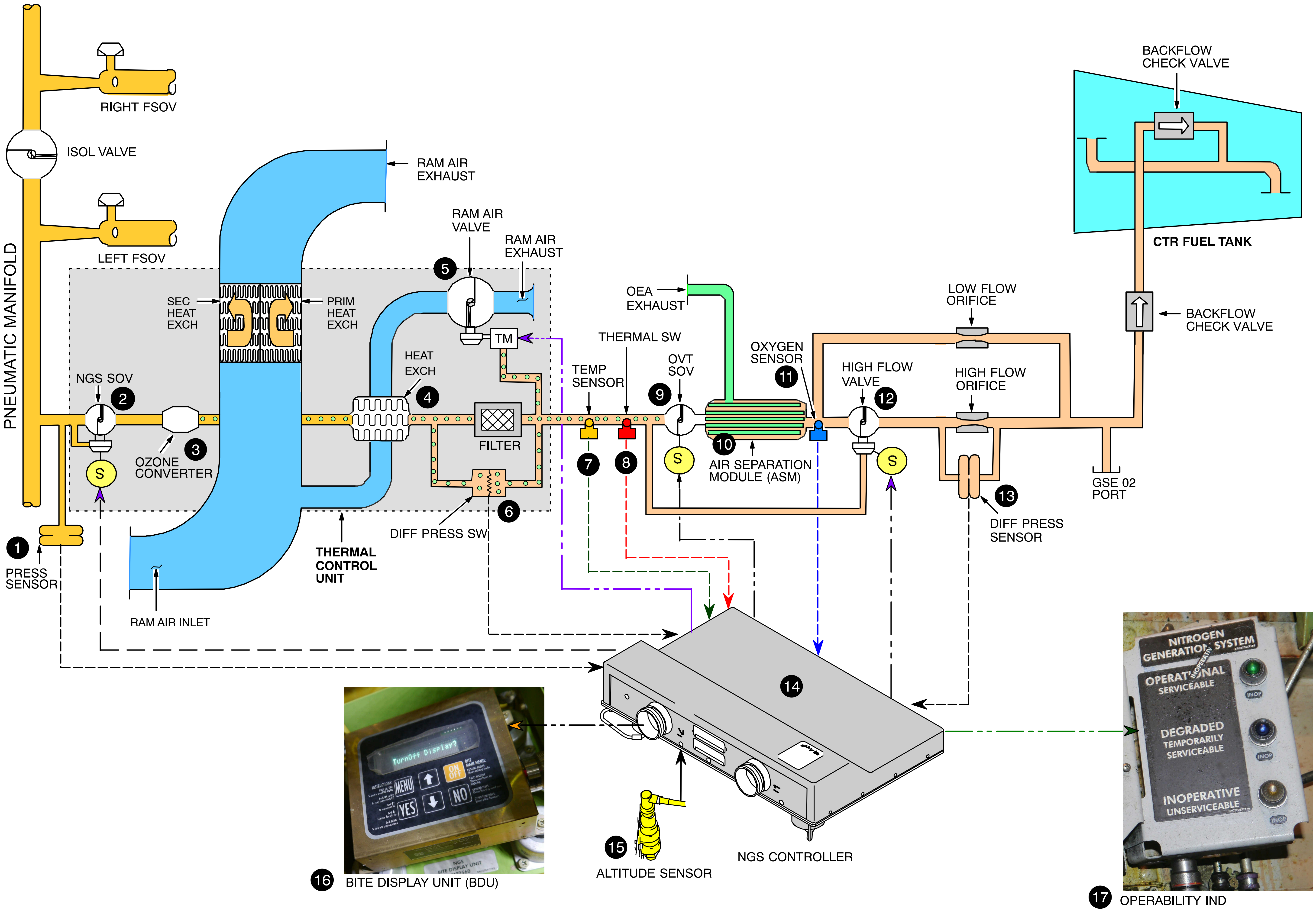
16 Bite Display Unit

You use the BITE display unit to do a test of the system.

17 Operability Indicator

An operability indicator gives a visual indication of the condition of the system.

- OPERATIONAL - Green light
  System operates correctly.
- DEGRADED - Blue light
  System is serviceable, but at a decreased capacity.
- INOP - Amber light
  System is not serviceable.


RIGHT FSOV
ISOL VALVE
LEFT FSOV
PNEUMATIC MANIFOLD
RAM AIR EXHAUST
RAM AIR VALVE
RAM AIR EXHAUST
SEC HEAT EXCH
PRIM HEAT EXCH
HEAT EXCH
TM
FILTER
NGS SOV
OZONE CONVERTER
S
PRESS SENSOR
RAM AIR INLET
THERMAL CONTROL UNIT
DIFF PRESS SW
OEA EXHAUST
THERMAL SW
TEMP SENSOR
OVT SOV
OXYGEN SENSOR
AIR SEPARATION MODULE (ASM)
HIGH FLOW VALVE
LOW FLOW ORIFICE
HIGH FLOW ORIFICE
DIFF PRESS SENSOR
GSE 02 PORT
BACKFLOW CHECK VALVE
BACKFLOW CHECK VALVE
CTR FUEL TANK
1
2
3
4
5
6
7
8
9
10
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12
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16
17
NGS CONTROLLER
ALTITUDE SENSOR
BITE DISPLAY UNIT (BDU)
OPERABILITY IND
Turn Off Display?
MENU
YES
NO
ON OFF
NITROGEN GENERATION SYSTEM
OPERATIONAL SERVICEABLE
DEGRADED TEMPORARILY SERVICEABLE
INOPERATIVE UNSERVICEABLE
INOP

Reference to Figure 81 Lubrication System Schematic

ATA 49 APU

49-90 APU LUBRICATION SYSTEM

SYSTEM DESCRIPTION

GENERAL DESCRIPTION

Supply

The APU lubrication system supplies pressurized oil to cool, clean, and lubricate APU components and the APU generator. Oil pumps in the lube module pump oil from the reservoir in the gearbox. Pressurized oil from the lube module goes to the oil cooler and then returns to the lube module.

Scavenge

Scavenge pumps in the lube module send the oil from the turbine bearing compartment back to the gear box reservoir. Other scavenge pump elements send the scavenge oil from the APU starter-generator through the scavenge filter and back to the gearbox reservoir.

Vent

An air-oil separator separates the air that mixes with the oil in the scavenge system. The air-oil separator returns the oil to the sump in the gearbox and the air vents overboard.

1 OIL SUMP

The APU sump holds 5.4 liters of oil when full. An oil-level sight glass shows the oil level.

2 LUBE AND SCAVENGE PUMPS

The Lube and scavenge pumps are on a common shaft. Three of the pumps are lube pumps. Three elements are starter-generator scavenge pumps, and one is a turbine bearing scavenge pump.

3 Pressure Regulating/Relief Valve

The pressure regulating/relief valve keeps the oil pressure at 60 to 74 psi. If the pressure is more than this, the valve returns the oil to the oil pump inlet. The relief valve is set at 200 to 280 psi.

4 Temperature Control Valve

The temperature control valve controls the oil flow to the oil cooler to control oil temperature and to bypass the oil cooler when the oil is cold.

When the oil temperature is 60°C or less, the valve is fully open and the oil does not go to the oil cooler. When the oil temperature is 78°C or more, the valve is fully closed and the oil goes to the oil cooler. Between temperatures of 60°C and 78C, the valve is not fully open.

A pressure difference of 50 psid also opens the valve to permit the oil to continue to flow if the oil cooler clogs.

Oil Filter Elements

There are two interchangeable oil filters. The oil from the APU generator goes through the generator filter element. Pressurized oil goes through the oil filter element after it goes through the oil cooler.

5 OIL FILTER BYPASS VALVE & INDICATOR

When there is a pressure difference of more than 26 to 40 psid across the oil filter and the oil temperature is more than 20°C, the indicator button extends (filter clogged).

The bypass valve bypasses oil if there is a clog (50 to 70 psid) or the oil is cold.

6 GEN Filter Bypass Valve & Filter Sw

The generator filter element has a filter pressure switch to monitor for filter clogs. When there is a pressure difference of more than 30 to 40 psid across the filter, the switch sends a signal to the ECU. The ECU shutdown the APU if these occur:

- High filter delta pressure
- Oil temperature is more than 38°C
- Main engines not running for 90 seconds.

The generator filter element also has a bypass valve to allow the oil to flow if there is a clog or the oil is cold. The bypass valve bypasses oil at 50 to 70 psid.

7 Oil Temperature Sensor

The oil temperature sensor sends lube oil temperature data to the ECU. The ECU shuts down the APU if the APU speed is above 95% and the oil temperature is 143°C or more.

8 Low Oil Pressure Switch

The LOP SW sends a signal to the ECU when the oil pressure is less than 30-40 psi. If the APU speed is more than 95%, the ECU shuts down the APU after 20 seconds.

9 Electronic Control Unit (ECU)

The ECU controls APU functions. The ECU also contains circuits for fault detection and isolation.

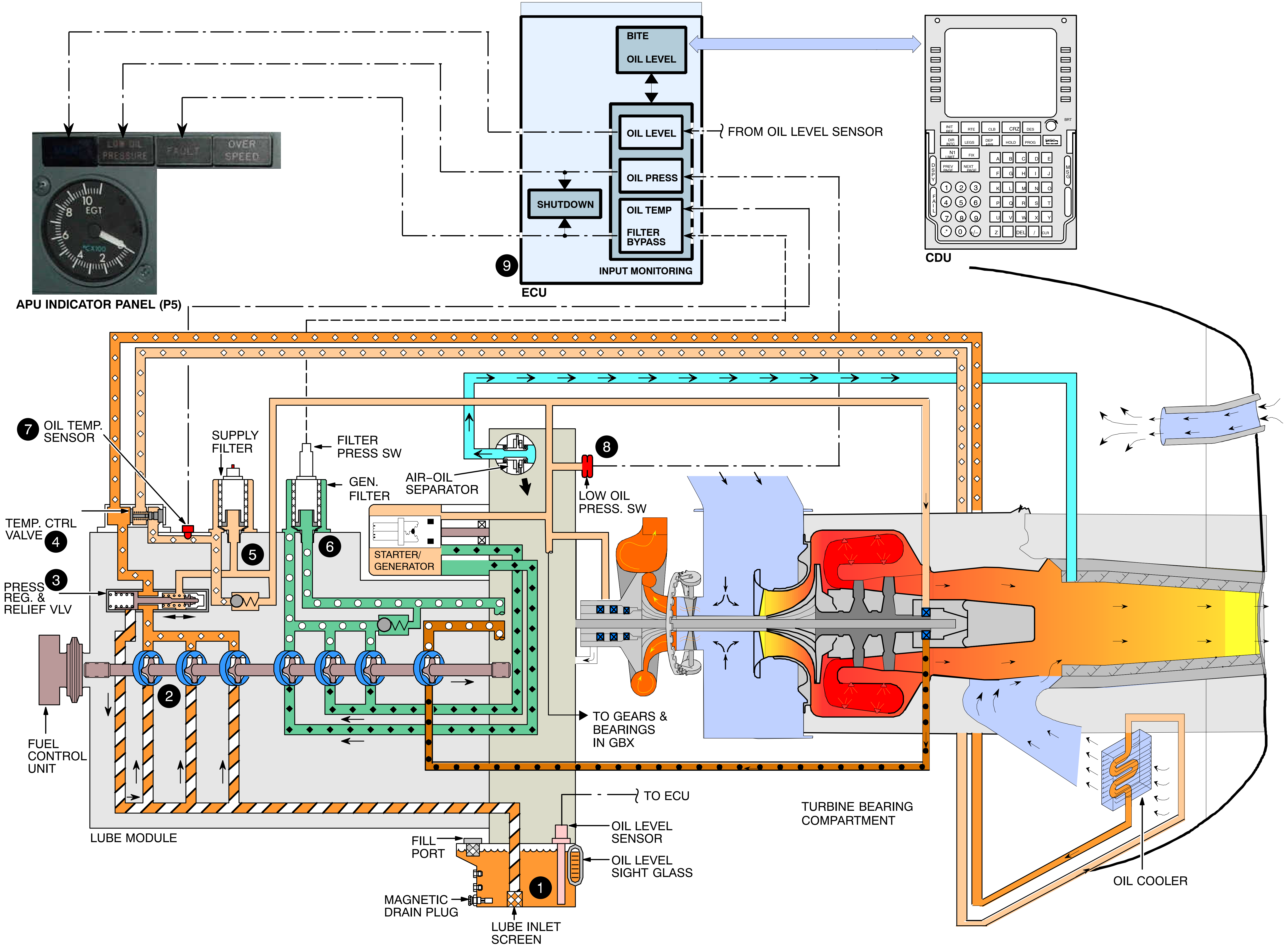


Figure 81 Lubrication System Schematic

Reference to Figure 82 Fuel System Schematic

49-30 APU FUEL SYSTEM

SYSTEM DESCRIPTION

1 Fuel Shutoff Valve

The airplane fuel system ac boost pumps or the APU dc boost pump supply fuel for APU operation.
The fuel shutoff valve opens when the APU switch is in the ON position.

2 High Pressure Fuel Pump

A shaft from the lube module turns the high pressure fuel pump. The pump gives high pressure fuel for use in the FCU.

3 Pump Relief Valve

The relief valve keeps fuel pressure below 950 psi.

4 High Pressure Filter

The high pressure filter removes contamination caused by the gear pump.

5 Actuator Pressure Regulator

The actuator pressure regulator keeps actuator fuel pressure at 250 psid. The FCU uses actuator fuel pressure to operate the inlet guide vane actuator and surge control valve.

6 ECU

The ECU calculates the correct fuel flow for APU start and run. The ECU uses these values to calculate the correct fuel flow:
- APU speed
- APU exhaust gas temperature (EGT)
- Inlet temperature (T2)
- Inlet pressure (P2)
- Fuel temperature.

The ECU sends the fuel flow command signal to the fuel metering valve.

7 Fuel Metering Valve

The ECU controls the fuel metering valve when the APU speed is more than 7%.

8 Differential Pressure Regulator

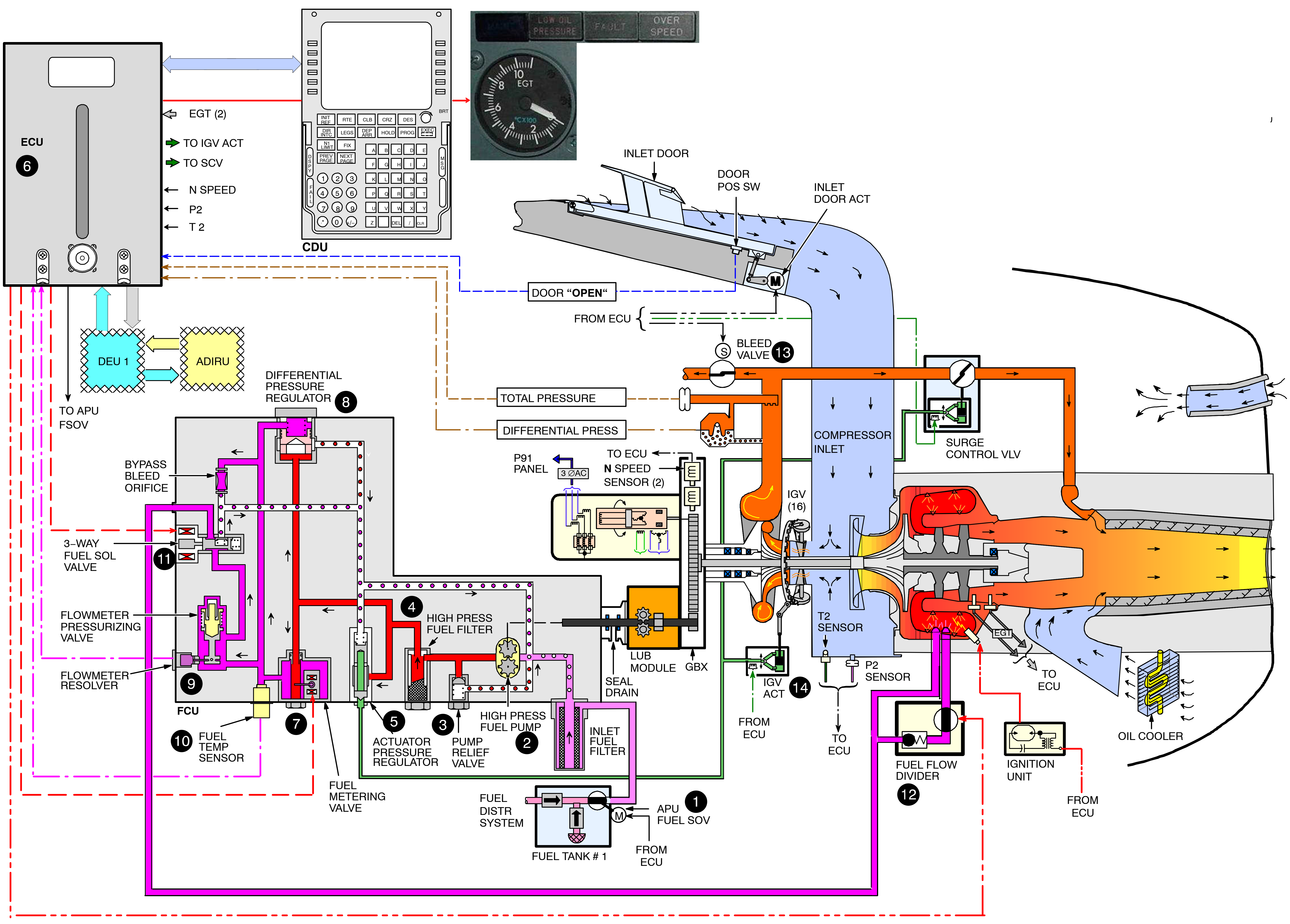
The differential pressure regulator holds a constant differential pressure of 50 psid across the metering valve.

9 Flow Meter Press. Valve & Resolver

The flow meter pressurizing valve keeps a 50 psi decrease in fuel pressure from the fuel metering valve to the fuel shutoff solenoid. A resolver attaches to the valve measure the actual fuel flow and send this signal to the ECU.

10 Fuel Temperature Sensor

The fuel temperature sensor send a fuel temperature signal to the ECU.


ECU
6
EGT (2)
TO IGV ACT
TO SCV
N SPEED
P2
T 2
CDU
LOW OIL PRESSURE
FAULT
OVER SPEED
EGT
INLET DOOR
DOOR POS SW
INLET DOOR ACT
DOOR "OPEN"
FROM ECU
BLEED VALVE
13
DEU 1
ADIRU
TO APU FSOV
DIFFERENTIAL PRESSURE REGULATOR
8
TOTAL PRESSURE
DIFFERENTIAL PRESS
COMPRESSOR INLET
SURGE CONTROL VLV
P91 PANEL
3 ØAC
TO ECU
N SPEED SENSOR (2)
IGV (16)
BYPASS BLEED ORIFICE
3-WAY FUEL SOL VALVE
11
FLOWMETER PRESSURIZING VALVE
FLOWMETER RESOLVER
9
FCU
4
HIGH PRESS FUEL FILTER
LUB MODULE
GBX
SEAL DRAIN
T2 SENSOR
P2 SENSOR
EGT
TO ECU
IGV ACT
14
FROM ECU
TO ECU
OIL COOLER
10
FUEL TEMP SENSOR
7
5
ACTUATOR PRESSURE REGULATOR
3
PUMP RELIEF VALVE
HIGH PRESS FUEL PUMP
2
INLET FUEL FILTER
FUEL FLOW DIVIDER
12
IGNITION UNIT
FROM ECU
FUEL METERING VALVE
FUEL DISTR SYSTEM
APU FUEL SOV
1
M
FUEL TANK # 1
FROM ECU

Reference to Figure 83 Fuel System Schematic (Cont.)

11 Fuel Solenoid Valve

The fuel solenoid valve controls the fuel flow from the fuel control unit. The fuel solenoid valve is spring loaded closed. During APU start, the ECU energizes the solenoid at 7% speed. This opens the fuel solenoid valve.

During shutdown, the ECU deenergizes the solenoid. The fuel solenoid valve closes.

12 Fuel Flow Divider

The fuel flow divider gives fuel to the primary manifold during start of the APU. At 25−40% speed or approximately 120 psi, the fuel flow divider gives fuel to both the primary and secondary fuel manifolds for APU operation.

The fuel flow divider has a normally open flow divider solenoid. The ECU signals the flow divider solenoid closed above 25,000 feet (7,620 meters) altitude to make sure the internal check valve for secondary fuel does not open and cause the APU speed to decrease.

13 APU Bleed Valve (BAV)

The APU BAV (**B**leed **A**ir **V**alve) isolates the APU bleed air system form the airplane pneumatic manifold.

With the APU bleed switch in the ON position and APU speed above 95%, the ECU sends a signal to open the BAV.

14 Inlet Guide VanE (IGV) Actuator

The inlet guide vanes control the air flow to the load compressor. The IGV actuator controls the IGV position. The vanes not fully close, they are set to stop at the 15° position to cool the load compressor.The actuator receives signals from the ECU and uses fuel pressure from the FCU to move the vanes.

15 APU Surge Control Valve (SCV)

The SCV releases air from the load compressor. The SCV makes sure there is a minimum flow of air through the load compressor. This prevents a surge.

16 IGNITION SYSTEM

The ignition system supplies sparks to start APU combustion during the APU start.

The ignition unit changes 28v dc power to a high voltage pulsed current that goes to the igniter plug.

The ECU energizes the ignition unit at 0% speed and deenergizes the ignition unit at 60% speed. The ECU energizes the ignition system again, if the APU engine speed goes below 95% speed during APU operation (speed droop).

START SYSTEM

The starter−generator, SPU, and SCU together supply initial rotation of the APU. The start power sources are 28v dc from the battery or 115v ac transfer bus # 1.

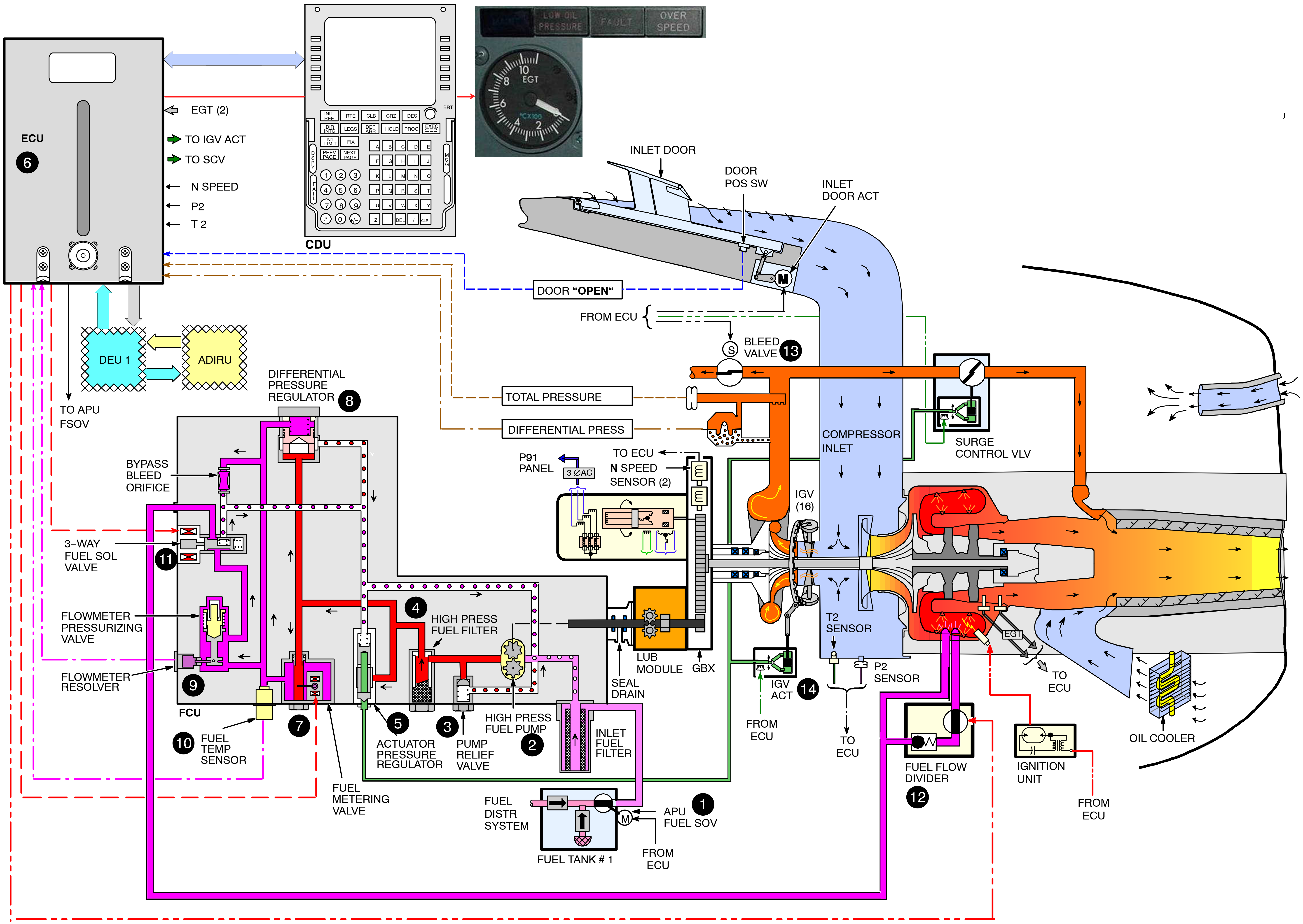


Figure 83 Fuel System Schematic (Cont.)

Reference to Figure 84 ATA51-57 General

ATA 51-57 STRUCTURE

51-00 STRUCTURE GENERAL

SYSTEM DESCRIPTION DOORS

GENERAL DESCRIPTION

The structure of the airplane is designed to provide maximum strength with minimum weight. This object has been achieved by designing alternate load paths into the structure, so that a failure of one segment cannot endanger theairplane, and also by the use of appropriately selected materials. The materials most commonly used throughout the structure are aluminum, steel, and magnesium alloys. Of these, the most extensively used are certain aluminum alloys selected according to the particular type of load they are best suited to withstand. Aluminum and composite honeycomb core material is used extensively on secondary areas of structures and many of the flight surfaces.

Fuselage

The fuselage main frame includes frames, bulkheads, formers, longerons, stringers, keel beam and frames around openings. The fuselage is a semimonocoque structure with the skin reinforced by circumferential frames and longitudinal stringers.

Wings

Most of material in the wing is aluminium. These components are attached to the wing structure:

- Engine nacelle/pylon
- Flight control surfaces
- Wing tip

The wings contain the main fuel tanks. The wing has two reference dimensions. The reference dimensions give wing locations in inches. Measure each location from buttock line 0. These are the wing reference dimensions:

- Wing station
- Wing buttock line.

Measure the wing station perpendicular to the wing leading edge. You measure the wing buttock line parallel to the buttock line.

Horizontal Stabilizer

Most of material in the horizontal stabilizer is aluminum. The elevator is graphite composite. The horizontal stabilizer has three reference dimensions. These reference dimensions give horizontal stabilizer locations in inches. Measure each location from buttock line 0. These are the horizontal stabilizer reference dimensions:

- Stabilizer station
- Stabilizer leading edge station
- Elevator station

Measure stabilizer stations perpendicular to the horizontal stabilizer rear spar. Measure stabilizer leading edge stations perpendicular to the horizontal stabilizer leading edge. Measure elevator stations perpendicular to the elevator hinge centerline.

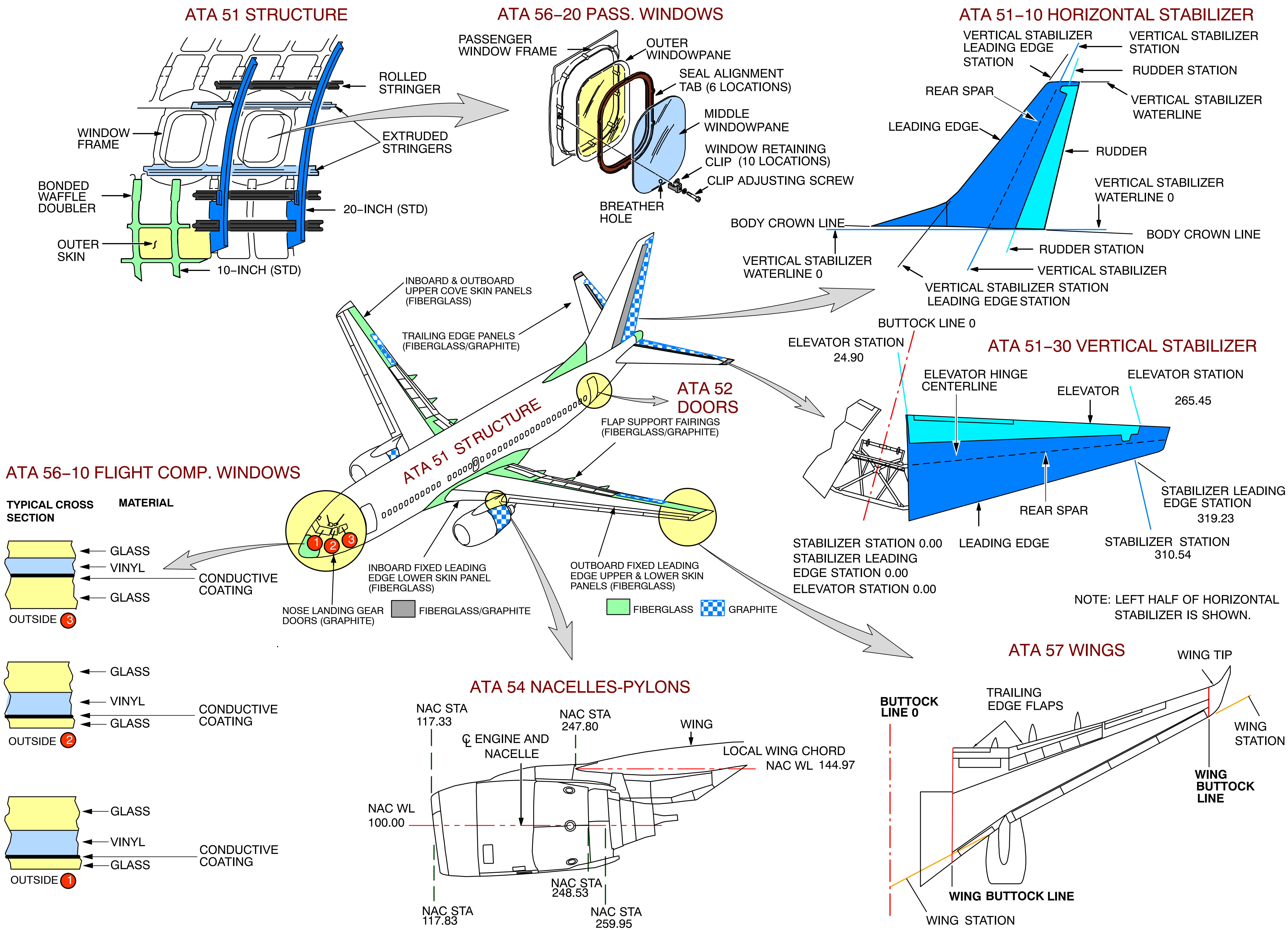


Figure 84 ATA51-57 General

Reference to Figure 85 ATA51-57 General

Vertical Fin

Most of material in the vertical stabilizer is aluminum. The rudder is graphite composite. The vertical stabilizer has four reference dimensions. These reference dimensions give vertical stabilizer locations in inches. These are the vertical stabilizer reference dimensions:

- Vertical stabilizer station
- Vertical stabilizer leading edge station
- Rudder station
- Vertical stabilizer waterline.

Measure the vertical stabilizer station perpendicular to the vertical stabilizer rear spar. Vertical stabilizer station 0 starts at the body crown line. Measure the vertical stabilizer leading edge station perpendicular to the vertical stabilizer leading edge. Vertical stabilizer leading edge station 0 starts at the body crown line. Measure the rudder station perpendicular to the rudder hinge centerline. Rudder station 0 starts at the body crown line. Measure the vertical stabilizer waterline parallel to the body waterline.

Engine Nacelle Pylon

The nacelle is the fairings and the components that surround the engine. The nacelle gives an aerodynamically smooth surface to the strut and engine. Nacelle stations and waterlines give locations on the nacelle-pylon. The scale for nacelle stations and waterlines is inches. The station line is a horizontal dimension. It starts at station line zero. The water line is a height dimension. You measure the water line from a horizontal reference plane below the nacelle-pylon.

Composite Material

Some airplane structure and parts are composite materials. These are some advantages of composite materials:

- Corrosion resistant
- Increased fatigue life
- Light weight

Composite material is used on this plane for the secondary structure only (e.g. fairings, radome, etc.).

Flight Compartment Windows

The purpose of the airplane windows is to provide:

- Visual means to fly the airplane and for collision avoidance
- emergency exit from the flight compartment

There are six windows symmetrically located around the flight compartment. Windows No. 1, 3 are fixed in place. Window No. 2 is a sliding window, mounted on tracks.

Passenger Compartment Windows

The passenger compartment windows are plug-type windows.They consist of outer, middle and inner panes. The inner pane is nonstructural and is mounted in the sidewall lining. The outer and middle panes are each capable of taking the full cabin pressurization load. Fail-safe structure is ensured by the middle pane.

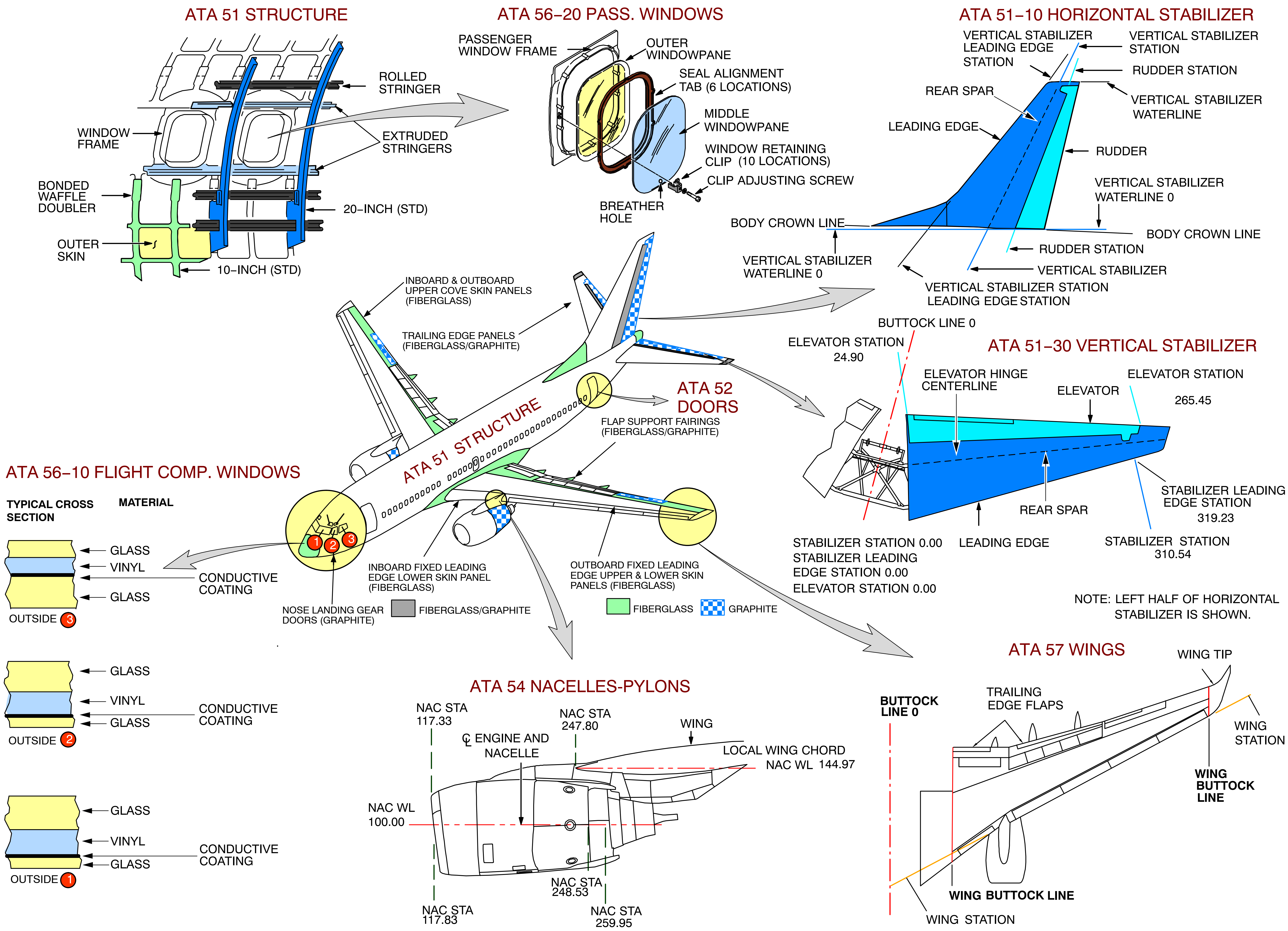


Figure 85 ATA51-57 General

Reference to Figure 86 Body Station Diagram, Reference Planes and Lines, Doors

ATA 52 / 53 DOORS / FUSELAGE

52/53-00 DOORS/FUSELAGE GENERAL

SYSTEM DESCRIPTION FUSELAGE

GENERAL DESCRIPTION

The fuselage is a semi-monocoque structure. Most of material in the fuselage is aluminum. It is a structurally sound and aerodynamically contoured body which supports the wings, stabilizers and landing gear. Most of it is pressurized for the coverage of payload.
A typical section through the fuselage consists of an upper and a lower oval which intersect approximately at the floor level. At the intersection, the fuselage is reinforced by transverse floor beams. Above this floor structure, which extends from the front pressure bulkhead at Body Station 178 to the rear pressure bulkhead at Body Station 1016, the upper lobe of the fuselage encloses the cabin and is basically a continuous shell, with cutouts in the skin for doors and windows. Below the floor the continuity of the lower lobe, which encloses the cargo compartments, is interrupted by several major structural features: the nose landing gear wheel well, the cavity for the center wing box, and the main landing gear wheel well.
Aft of the rear pressure bulkhead, the floor is discontinued and this section of the fuselage, which tapers towards its aft end, supports the vertical fin, the horizontal stabilizer, and contains a compartment for the APU.

- **Section 41**
- **Section 43**
- **Section 44**
- **Section 46**
- **Section 47**
- **Section 48**

Note: Section 48 is not pressurized.

Dimensions give locations on the fuselage. The scale for each dimension is inches. You use these dimensions to find components on the fuselage:

- Body station line (BS)
- Body buttock line (BBL)
- Body water line (BWL)

The body station line (BS) is a horizontal dimension. It starts at station line zero. You measure the body station line from a vertical reference plane that is forward of the airplane.

The body buttock line (BBL) is a lateral dimension. You measure the buttock line to the left or right of the airplane center line (LBL or RBL).

The body water line (BWL) is a height dimension. You measure the body water line from a horizontal reference plane below the airplane.

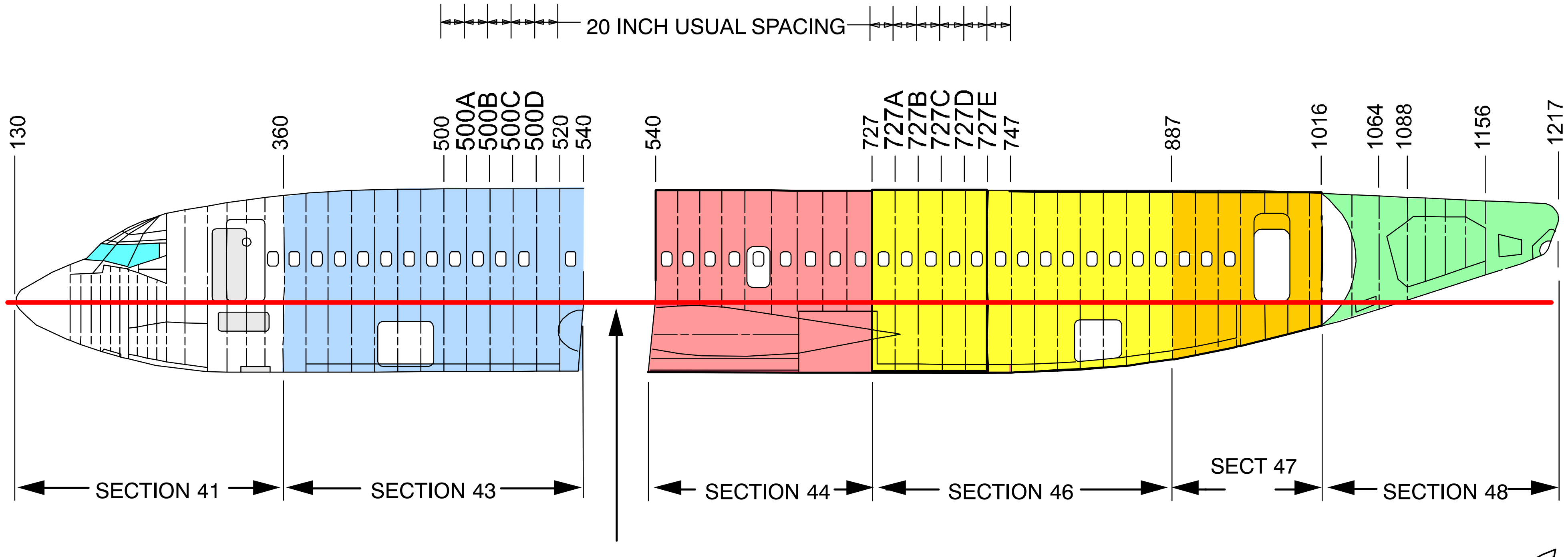
SYSTEM DESCRIPTION DOORS

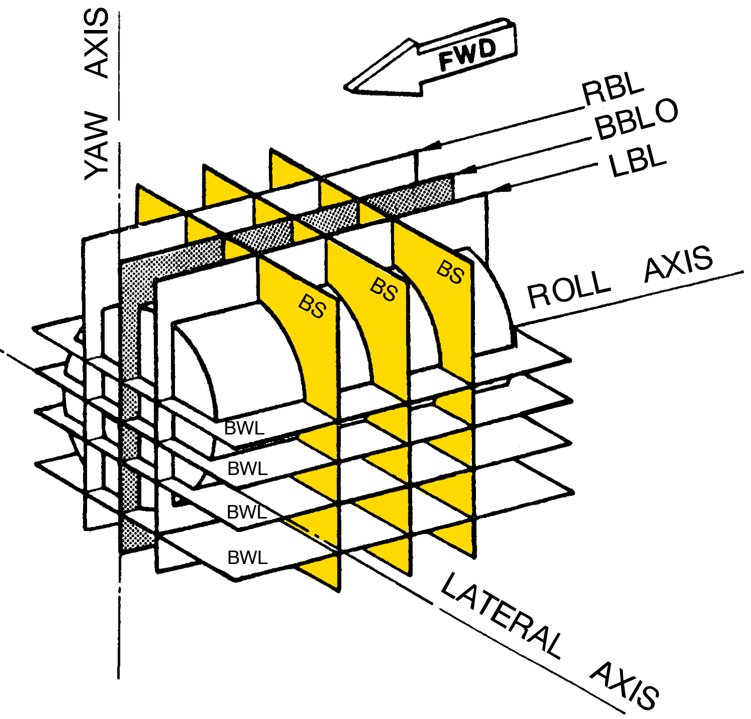
GENERAL DESCRIPTION

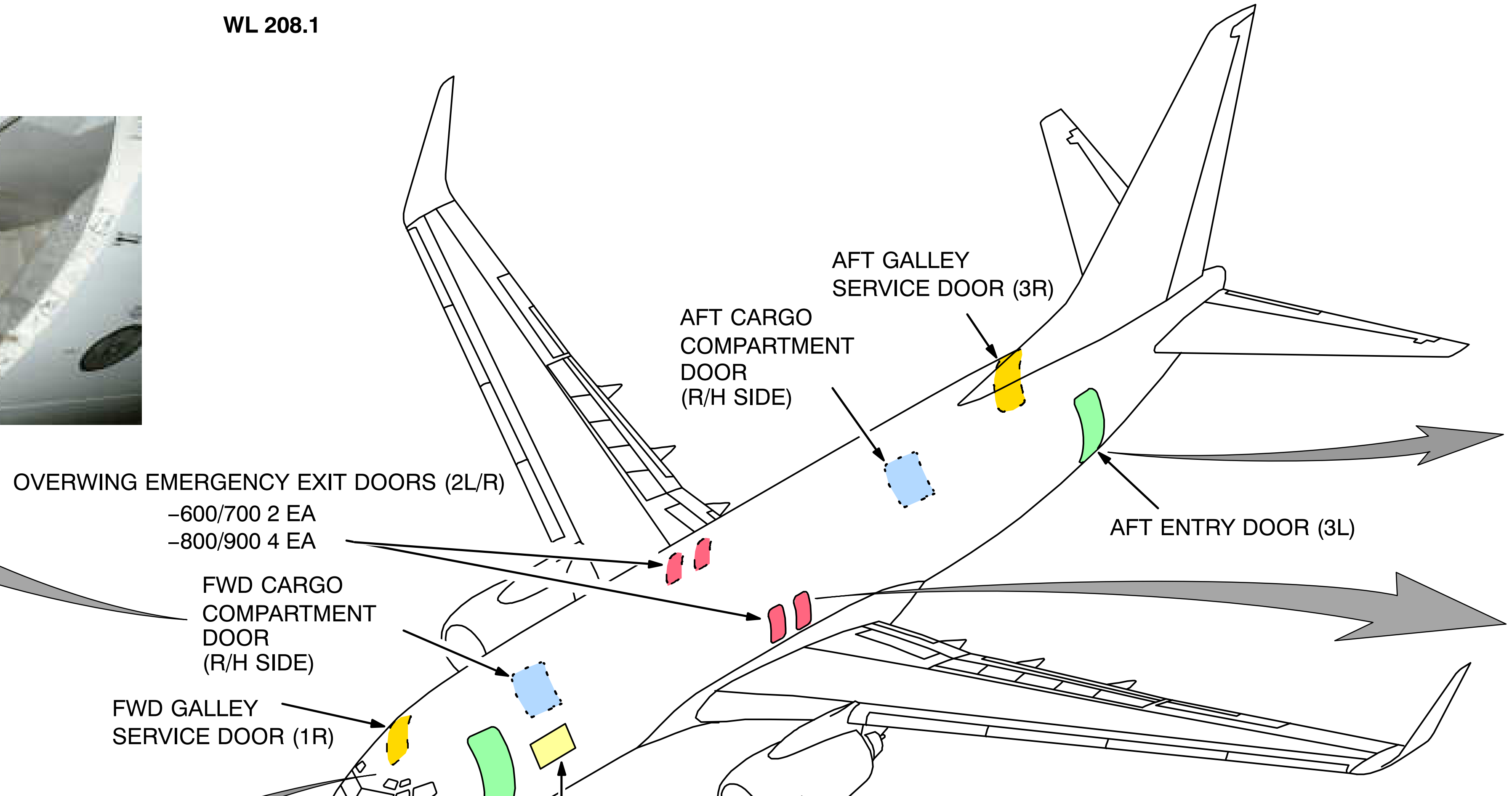
The doors are removable units that give access to the airplane compartments. These are the doors on the airplane:

- Forward and aft entry doors
- Forward and aft galley service doors
- Overwing emergency exit doors
- Cargo doors

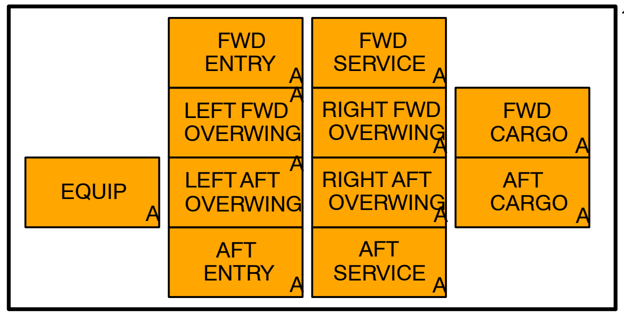
A door warning system shows the crew that pressure bearing doors are closed and properly latched before flight.







B737-800



DOOR WARNING ANNUNCIATOR PANEL (P5)

Figure 86 Body Station Diagram, Reference Planes and Lines, Doors

Reference to Figure 87 Fuel System Schematic

ATA 73 ENGINE FUEL

73-00 GENERAL

SYSTEM DESCRIPTION

AIRPLANE FUEL SYSTEM

The airplane fuel system supplies pressurized fuel from the center or main tank. The fuel goes from the tank through a boost pump and a spar valve before the fuel goes to the engine.

1 Aisle Control Stand

The EEC uses the TLRs (**T**hrust **L**ever **R**esolvers) on the aisle stand to get TRA (**T**hrust **R**esolver **A**ngle). The EEC uses this data to find the commanded engine thrust.

The start levers and fire handle send signals directly to the HPSOV in the HMU. This lets the flight crew shut down the engine in normal or emergency situations. The EEC does not close the HPSOV.
In the IDLE position, the start levers send a start signal to the EEC through the DEUs.

2 Low Pressure Fuel Pump

The engine AGB (**A**ccessory **G**ear**b**ox) turns a drive shaft to operate the fuel pump assembly.

The low pressure fuel pump is a centrifugal impeller pump. This type of pump can operate at low fuel inlet pressure and with fuel that is part liquid and part vapor. The low discharge pressure of this pump lets the heat exchangers be lighter and more efficient.

3 Idg Oil Cooler

The IDG (**I**ntegrated **D**rive **G**enerator) oil cooler cools the IDG oil. This also heats the engine fuel. Heating the fuel stops the formation of ice from the water in the fuel.

4 Fuel Filters

There are two fuel filters in the fuel pump assemblies, the fuel filter and the servo wash filter.
The servo wash filter cleans the fuel that goes to the servo section of the hydromechanical unit (HMU).

5 high pressure fuel pump

The high pressure pump is a single element, positive displacement gear pump. This type of pump produces high fuel pressures. This pressure is necessary to give a strong combustor fuel spray pattern and to operate the engine acuators that are part of the servo system.

6 servo fuel heater

The servo fuel heater is a heat exchanger which uses the warmer scavenge oil temperature to increase the servo fuel supply temperature.

7 Electronic Engine Control (EEC)

The EEC controls the engine fuel and engine air flow for thrust and turbine clearance control systems. Two channels in the EEC use input data to calculate the engine fuel and control outputs to operate the engine. The EEC controls

8 HMU

With EEC control, the HMU supplies fuel to operate the servo systems, and supplies metered fuel to the fuel nozzles. These are the servo fuel systems the EEC controls through the HMU:

- Variable stator vanes (VSVs)
- Variable bleed valves (VBVs)
- Transient bleed valve (TBV)
- Low pressure turbine active clearance control.
- High pressure turbine active clearance control.

The HPSOV (**H**igh **P**ressure **S**hutoff **V**alve) stops the metered fuel flow when it closes. The control signal to operate the HPSOV usually comes from the start lever. The fire handle switch can override the start lever to close the HPSOV. The ENG VALVE CLOSED light shows the position of the HPSOV.

9 fuel nozzle filter

The fuel nozzle filter collects contamination from the high pressure fuel pump and the HMU before it can go to the fuel nozzles.

10 fuel nozzles

All of the fuel nozzles have primary and secondary fuel flow. At approximately 15 psig, the fuel nozzles open in the primary fuel flow mode. When the fuel pressure increases to approximately 125 psig, the fuel nozzles also open in secondary fuel flow mode.

11 Engine Control Light & EEC Switches

The EEC sends a signal to the engine control light on the P5 aft overhead panel through the DEUs for some faults detected by the EEC.

The metered fuel goes from the HMU through the fuel flow transmitter and inline filter to the manifold.

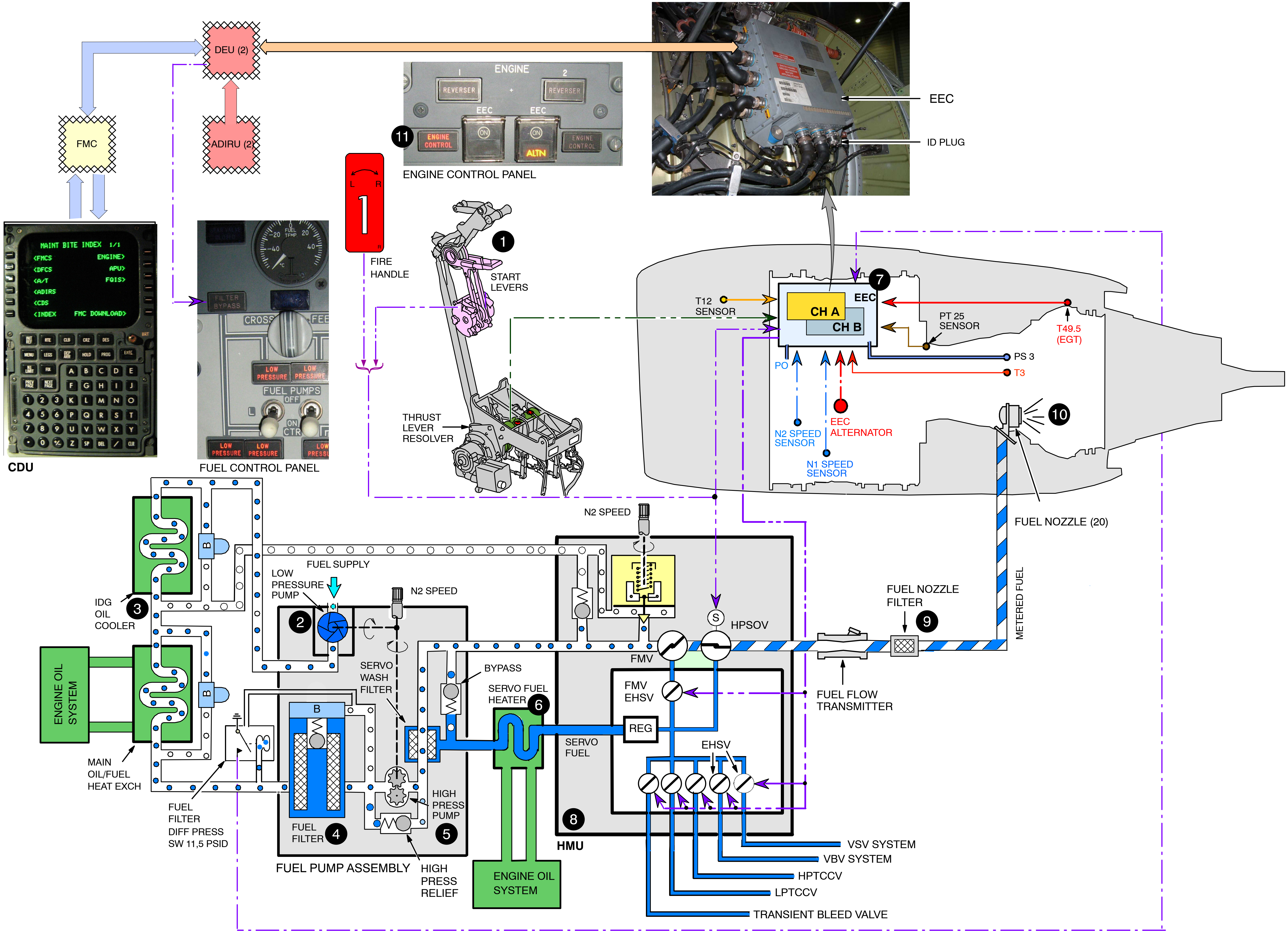


Figure 87 Fuel System Schematic

Reference to Figure 88 Ignition/Starting System Schematic

ATA 74/80 IGNITION/STARTING

74-00 GENERAL

SYSTEM DESCRIPTION

IGNITION SYSTEM

The ignition systems supply electrical sparks in the combustion chamber for combustion. Each engine has two ignition systems that operate independently. The ignition system usually operates manually. However, the ignition systems operate automatically when the EEC (**E**lectronic **E**ngine **C**ontrol) sees a possible engine flameout condition.

You use ignition during these times:

- Ground start
- Takeoff and Landings
- In-flight (during heavy turbulence or bad weather)
- In-flight start.

These components control ignition:

- Start levers
- Start switches
- Ignition selector switch
- EEC.

The start lever controls ignition system power to the EEC. The start switch and the ignition selector switch supply inputs to the EEC. The EEC uses these inputs to supply power to the ignition exciters. The ignition exciters supply power to the spark igniters.

Electrical Power

The engine 1 ignition systems receive 115 v ac from ac transfer bus 1 and the ac standby bus. The EEC has internal switches that control the 115v ac to the ignition exciters. The ignition exciters change the 115 v ac input to a dc voltage of approximately 15 000 to 20 000 v dc and 14.5 to 16 joules, for the spark igniters. The spark igniters give a spark for combustion. Usually, only one ignition exiter per engine operates at a time. The ignition systems of engine 2 receive ac power from ac transfer bus 2 and the ac standby bus.

START SYSTEM

The start valve controls pneumatic power to the starter. The valve opens for these engine operations:

- Ground start
- In flight starts which require starter assist
- Motoring.

The valve solenoid energizes when you put the engine start switch to the GRD position. This permits air pressure to the pneumatic actuator. The pneumatic actuator force is more than the torsion spring force and the start valve opens.

The DEUs use the valve position switch to supply indication in the flight compartment.

STARTER

Pneumatic power goes through an open start valve to turn the turbine air motor in the starter. The turbine turns the reduction gears and engages the clutch. The clutch transmits torque to the output shaft of the starter. The reduction gears engage the clutch as long as pneumatic power turns the turbine.

The starter output shaft turns the AGB. The AGB turns the engine N2 rotor through shafts and other gears.

At approximately 55% N2, the start valve closes and removes pneumatic power from the starter. The turbine and reduction gears slow and the clutch disengages. The starter output shaft then turns with the gearbox and engine. The turbine and reduction gears continue to slow until they stop.

START (CYCLE)

This occurs when you put the engine start switch to the GRD position when electrical and pneumatic power are available:

- A solenoid in the P5 panel energizes to hold the switch in the GRD position.
- The EEC receives an engine start signal
- The APU electronic control unit receives a signal to open the APU inlet guide vanes
- The start valve solenoid energizes and the valve opens
- The starter clutch engages and the engine N2 rotor turns

FUEL AND IGNITION

You move the engine start lever to the idle position to add fuel and ignition during the start.

STARTER CUTOUT

At approximately 55% N2 this occurs:

- The DEUs remove the electrical ground for the start switch solenoid
- The engine start switch goes to the OFF position
- The start valve solenoid deenergizes and the valve closes.

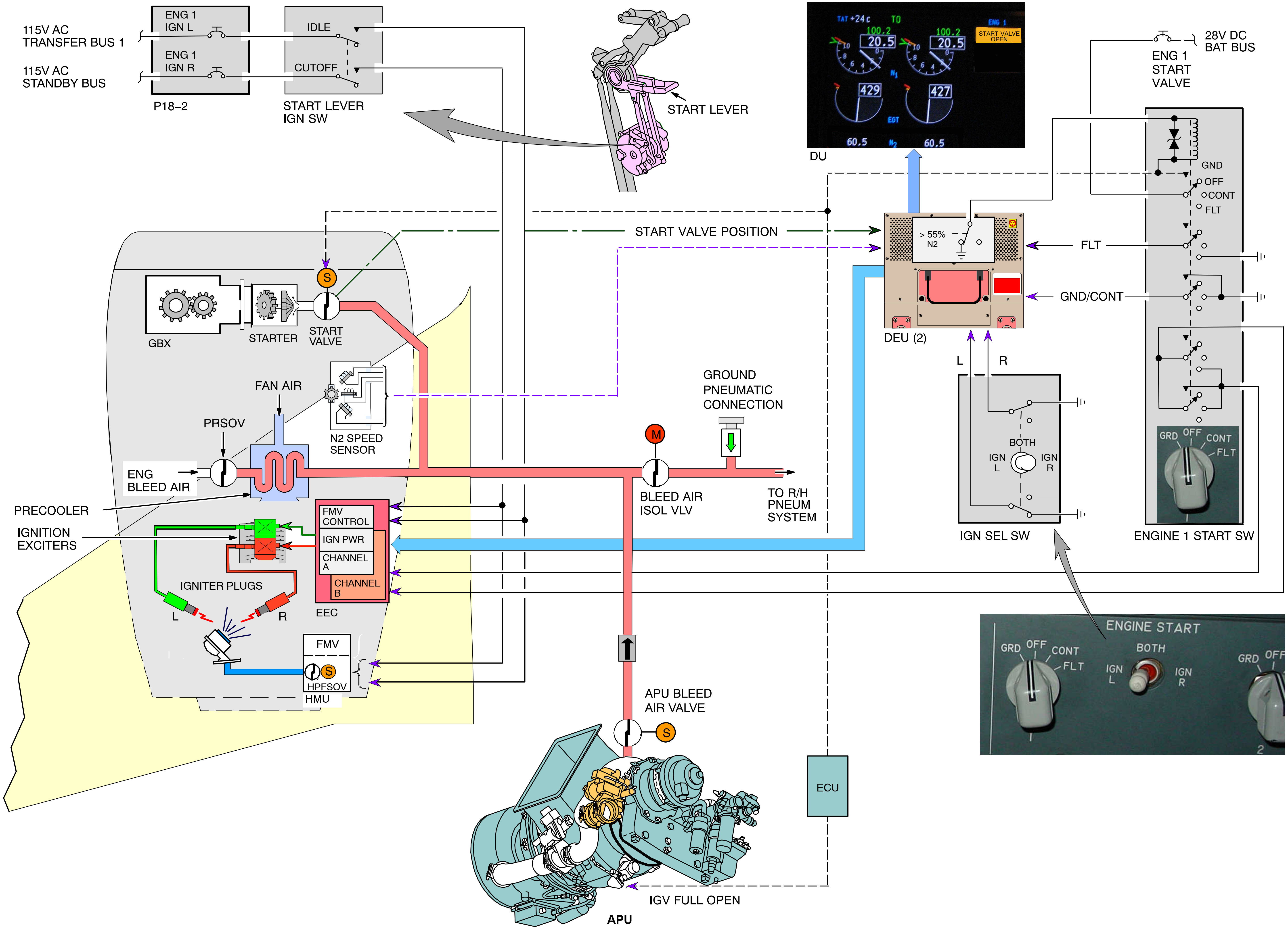


Figure 88 Ignition/Starting System Schematic

Reference to Figure 89 Engine Air System Schematic

ATA 75 ENGINE AIR

75-00 GENERAL

SYSTEM DESCRIPTION

During engine operation, the EEC (**E**lectronic **E**ngine **C**ontrol) receives airplane system data through the DEUs (**D**isplay **E**lectronic **U**nits). The EEC uses this data to control the engine air system. The EEC adjusts the bleed airflows to adjust the turbine blade tips clearances. The EEC also controls the compressor airflows to prevent stall. The EEC operates the air valves and the actuators through the HMU (**H**ydro**m**echanical **U**nit). HMU servo fuel pressure moves the valves and the actuators.

The engine air system has these subsystems:

- **Compressor Airflow Control**

  The engine air system adjusts the LPC (**L**ow **P**ressure **C**ompressor) and the HPC (**h**igh **P**ressure **C**ompressor) airflows for all power conditions. These adjustments prevent an engine stall.

- **Turbine Clearance Control**

  The engine air system adjusts the clearances between the HPT (**H**igh **P**ressure **T**urbine) blades and shroud, and the LPT (**L**ow **P**ressure **T**urbine) blades and shroud. Usually, the engine air system decreases the clearance between the rotors and the turbine case. This helps the engine use less fuel. The engine air system also increases the clearance between the high pressure turbine blades and shroud during some power conditions. This makes sure the HPT blades tips do not rub against the case.

1 Variable Stator Vanes (VSV)

The VSV system controls the HPC (**H**igh **P**ressure **C**ompressor) inlet airflow. The VSV system gives the correct quantity of air to the HPC. The EEC uses the HMU to control the VSV system. The HMU sends servo fuel pressure to move two VSV actuators. The two actuators move the variable stator vanes. Each actuator sends electrical position data to the EEC for closed-loop control.

2 Variable Bleed Valve (VBV)

The VBV system controls the LPC (**L**ow **P**ressure **C**ompressor) discharge airflow. The VBV system bleeds the LPC air out into the secondary airflow. The EEC uses the HMU to control the VBV system. The HMU sends servo fuel pressure to move two VBV actuators. The actuators cause the HPC discharge air bleed to the secondary airflow. Each actuator sends an electrical position data to the EEC for closed-loop control.

3 High Pressure Turbine Active Clearance Control (HPTACC)

The HPATCC system controls the 4th-stage air and the 9th-stage air to the HPT (**H**igh **P**ressure **T**urbine) shroud support. The air flows through an HPTACC valve. The EEC uses the HMU to control the position of the HPTCC valve. The HMU sends servo fuel pressure to move the HPTACC valve actuator. The HPTACC actuator sends electrical position data to the EEc for closed-loop control.

4 Low Pressure Turbine Active Clearance Control (LPTACC)

The LPTACC system controls the amount of fan discharge air that goes to the LPT (**L**ow **P**ressure **T**urbine) case. The air flows through the LPTACC valve. The EEC uses the HMU to control the position of the LPTACC valve. The HMU sends servo fuel pressure to move the LPTACC valve actuator. The LPTACC actuator sends electrical position data to the EEC for closed-loop control.

5 Transient Bleed Valve (TBV)

The TBV sends HPC 9th-stage air to the low pressure turbine stage 1 nozzles for these two conditions:

- Engine start
- Engine acceleration.

The EEC uses the HMU to control the TBV system. The HMU sends a servo fuel pressure to move the TBV actuator. The transient bleed valve sends an electrical position data to the EEC for closed-loop control.

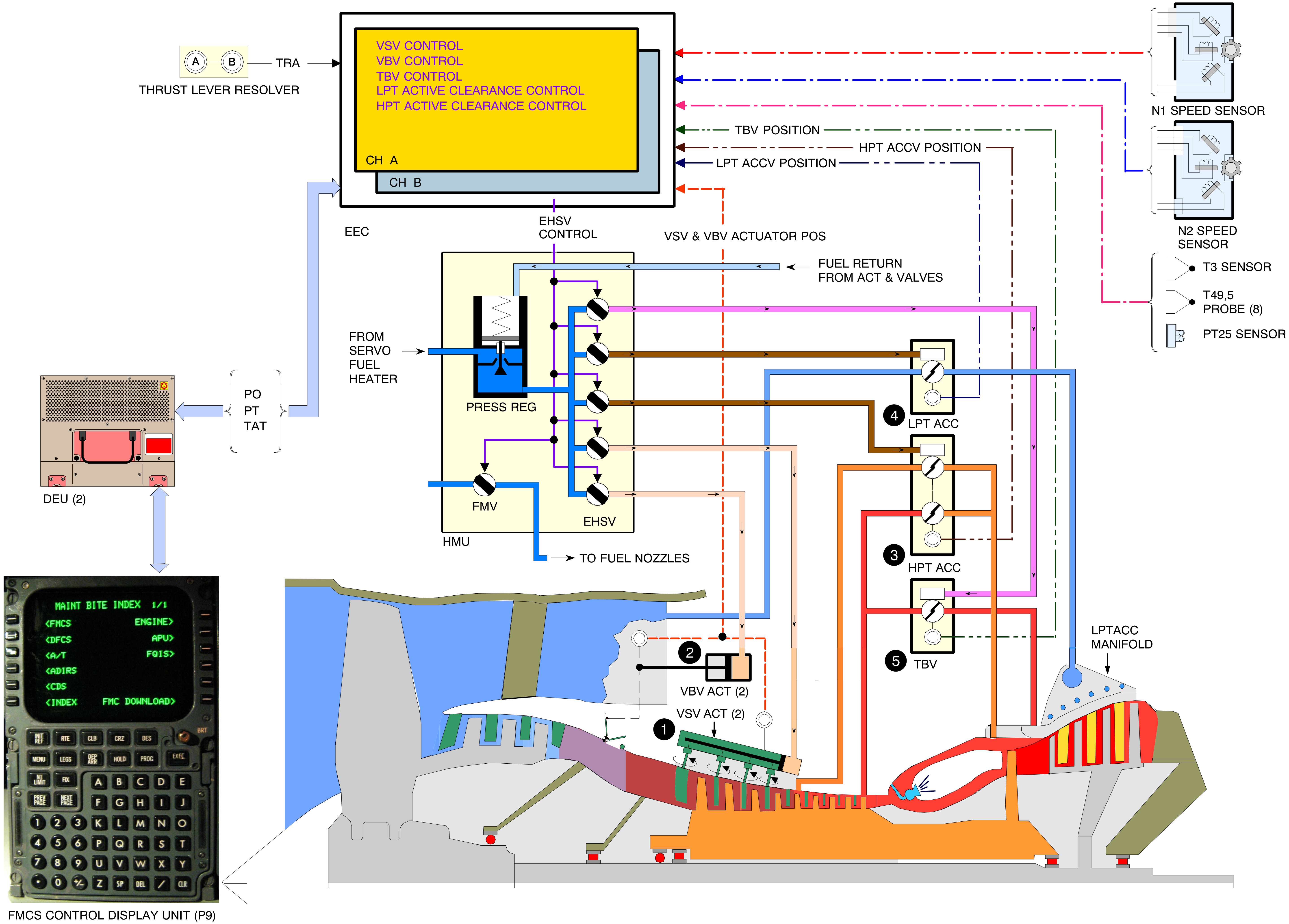


Figure 89 Engine Air System Schematic

Reference to Figure 90 Thrust Controls System Schematic

ATA 76 ENGINE CONTROLS

76-00 GENERAL

SYSTEM DESCRIPTION

The engine control system supplies manual and automatic control inputs to control the engine thrust. It also supplies signals to other airplane systems that require engine control status.
The engine control system has these components:

- Thrust levers (forward and reverse)
- Engine start levers and switches
- Thrust lever interlock solenoids.

1 Thrust Levers

You use the thrust levers to supply the manual inputs to the engine control system.

An interlock latch prevents the operation of the forward thrust lever and the reverse thrust lever at the same time.

2 Resolver

The resolver changes the forward and reverse thrust lever positions to an analog electric signal. This signal is sent to the EEC for each engine.

3 Reverse Thrust Interlock Solenoids

There are two reverse thrust interlock solenoids, one for each engine. Each reverse thrust interlock solenoid limits the range of motion of a reverse thrust lever. You can make the thrust reverser deploy, but you can not increase the reverse thrust until the thrust reverser sleeves are near the full deployed position. The EEC operates the solenoids.

4 Autothrottle Servomotor (ASM)

The thrust management function of the autothrottle system supplies the thrust command signal to the EEC. To do this, the ASM and gearbox assembly drives the TLA resolvers and the thrust levers through the clutch pack.

5 Autothrottle Switch Packs

Each switch pack has nine switches which supply discrete thrust lever position signals to various systems.

- S1 – auto ground speedbrake control and landing gear warning
- S2 – autobrake system
- S3 – autobrake system
- S4 – engine thrust reverser synchronous shaft locks
- S5 – engine thrust reverser control
- S6 – engine thrust reverser control
- S7 – wing thermal anti-ice system
- S8 – aural warning – takeoff warning and weather radar
- S9 – landing gear warning.

6 Start Levers

There are two start levers, one for each engine. Each start lever operates 6 switches.

- Two of the switches send signals to the EEC.
- Two of the switches interface with the engine ignition system.
- The other two switches send signals to valves in the engine fuel feed system.

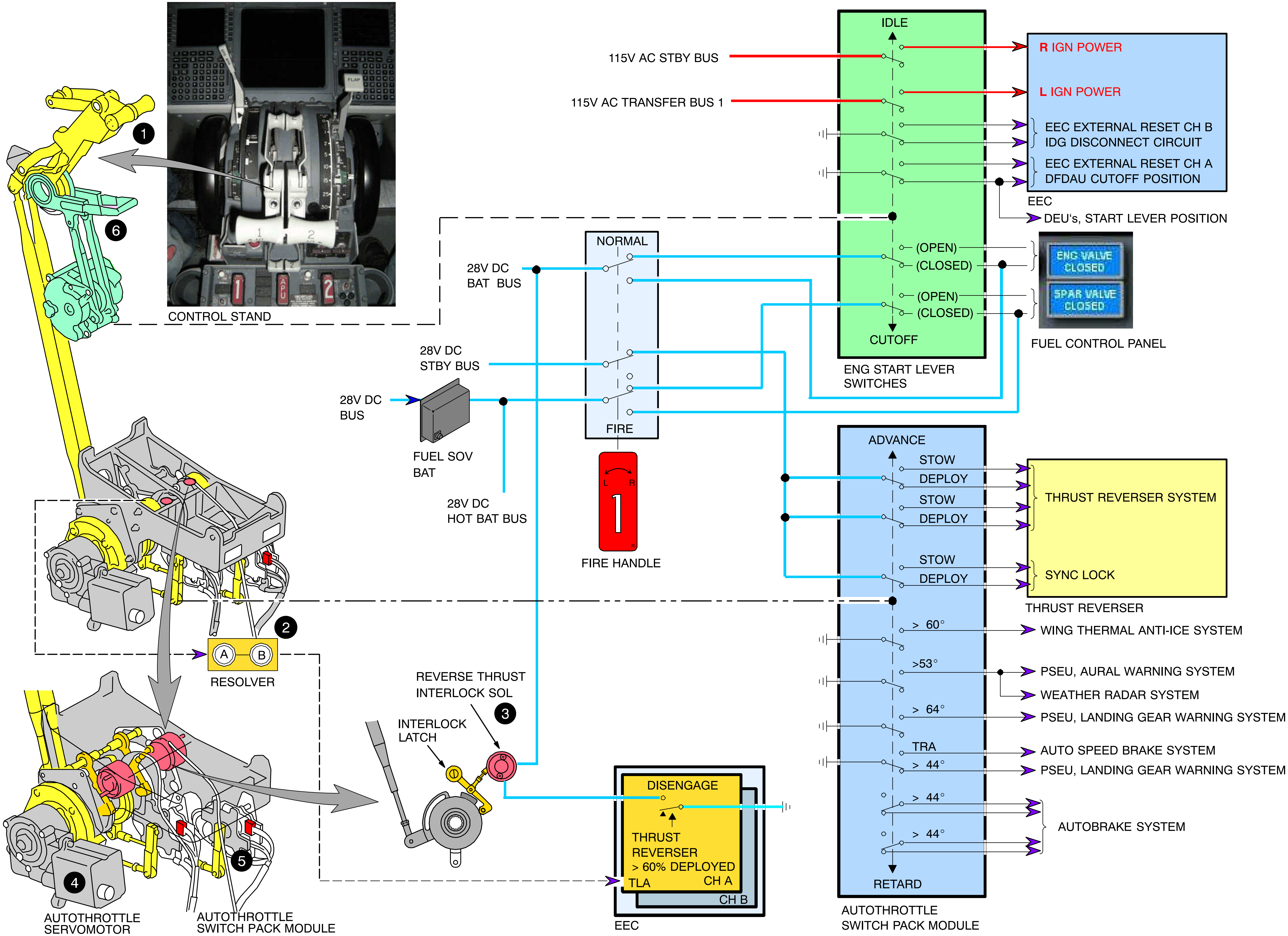


Figure 90 Thrust Controls System Schematic

Reference to Figure 91 Engine Indicating System Schematic

ATA 77 ENGINE INDICATING

77-00 GENERAL

SYSTEM DESCRIPTION

The engine indicating system shows these parameters for each engine:

- Low pressure rotor speed (N1)
- High pressure rotor speed (N2)
- Exhaust gas temperature (EGT)
- Engine vibration.

ELECTRONIC ENGINE CONTROL

The EEC (**E**lectronic **E**ngine **C**ontrol) receives an analog input from these engine sensors:

- N1 speed sensor
- N2 speed sensor
- EGT probes (T49.5).

The EEC changes the analog signals to digital signals. The EEC sends the digital signals on an ARINC 429 data bus to the CDS (**C**ommon **D**isplay **S**ystem) DEUs (**D**isplay **E**lectronics **U**nits).

AIRBORNE VIBRATION MONITORING SIGNAL CONDITIONER

The AVM (**A**irborne **V**ibration **M**onitoring) signal conditioner calculates and monitors vibration levels of each engine.

The AVM signal conditioner receives analog input from these engine sensors:

- N1 speed sensor
- N2 speed sensor
- Number 1 bearing vibration sensor, or
- FFCCV (**F**an **F**rame **C**ompressor **C**ase **V**ertical **V**ibration) sensor.

The DEUs and the FDAU (**F**light **D**ata **A**cquisition **U**nit) receive AVM information through an ARINC 429 data bus.

DEUS

The DEUs use input from the engine indicating system to show engine parameters on the CDS.

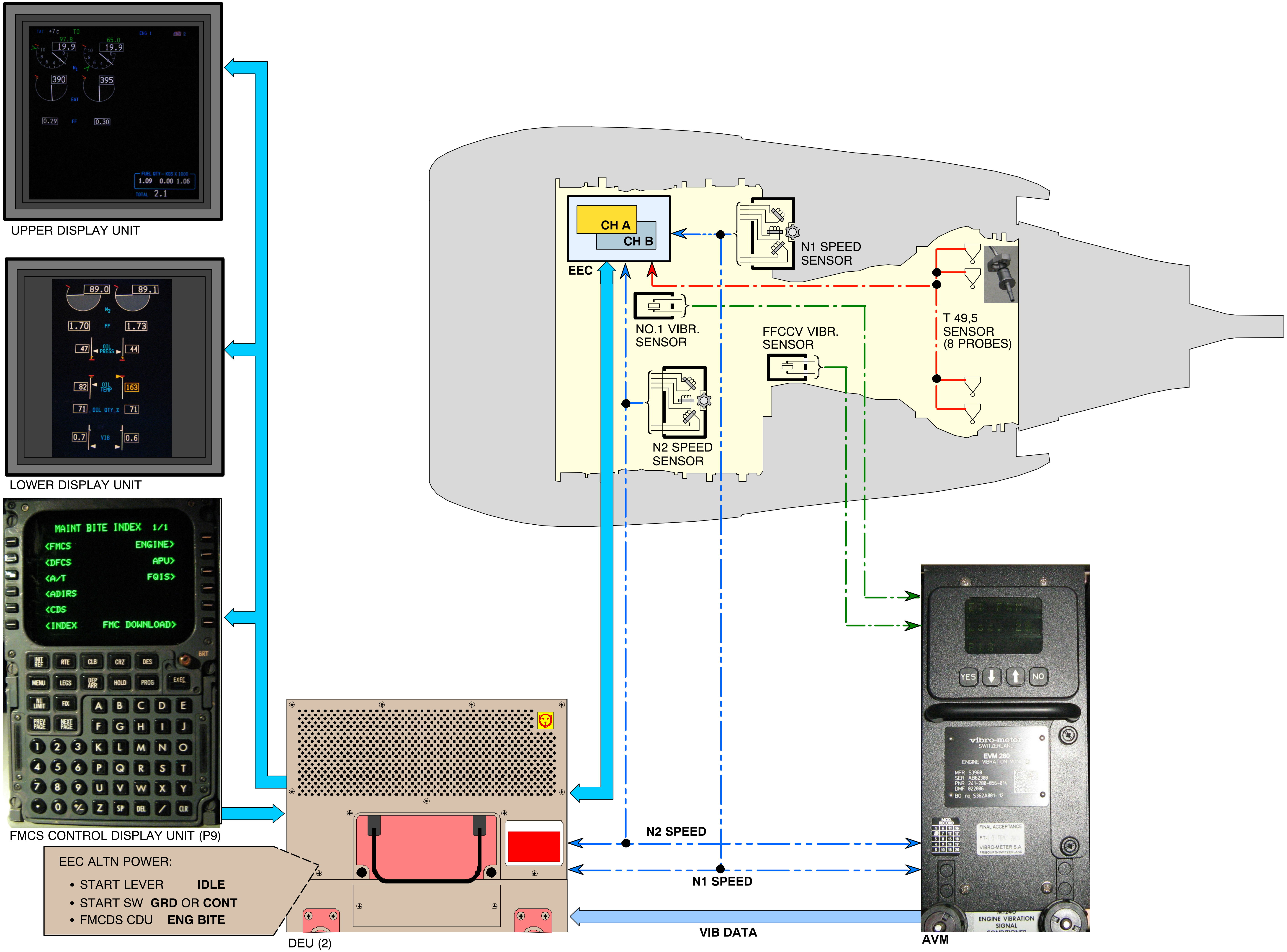


Figure 91 Engine Indicating System Schematic

Reference to Figure 92 Thrust System Schematic

ATA 78 THRUST REVERSER

78-30 GENERAL

SYSTEM DESCRIPTION

The T/R (**T**hrust **R**everser) system changes the direction of the fan air exhaust to help create reverse thrust. The flight crew uses reverse thrust to slow the airplane after landing or during a RTO (**R**ejected **T**ake-**O**ff). The turbine exhaust airflow direction does not change during reverse thrust.

Each T/R has a left and right half. Each half has a translating sleeve which moves aft for reverse thrust. The sleeves work at the same time, but are independent from each other. Three hydraulic actuators move each sleeve. Rotary flex shafts make sure that the hydraulic actuators extend and retract at the same rate.

T/R Control System

The T/R control system lets you deploy the T/R when the airplane is less than 3 meters from the ground. You give a deploy signal to the control system when you raise a reverse thrust Lever.

You supply a stow signal when you return the reverse thrust lever to the stow position.

The T/R control valve module controls hydraulic power to the hydraulic actuators. The reverse thrust lever operates the switches necessary to send a deploy or stow signal to the T/R control valve module.

The sync locks prevent the operation of the hydraulic actuators when there is no deploy signal.

The primary purpose of the EAU (**E**ngine **A**ccessory **U**nit) is to control the T/R stow operation. The EAU supplies front panel BITE (**B**uilt-**I**n-**T**est **E**quipment) to help you do trouble shooting of the control system. The EAU uses two T/R proximity sensors for each translating sleeve for control. The EAU also interfaces with the T/R indicating system to control the REVERSER light.

The T/R indicating system supplies these indications in the flight compartment:

- REV message on CDS (**C**ommon **D**isplay **S**ystem)
- REVERSER light on the P5 aft overhead panel
- LVDT (**L**inear **V**ariable **D**ifferential **T**ransformer) data on the **C**ontrol **D**isplay **U**nit (CDU).

The CDS (**C**ommon **D**isplay **S**ystem) shows the REV message. This message refers to the positions of a T/R's translating sleeves. Each T/R has LVDTs which supply translating sleeve position data to the EEC (**E**lectronic **E**ngine **C**ontrol).

When on, the REVERSER light shows that there is a failure in one of these areas:

- T/R control system
- Mechanical failure which prevents the control system from correct operation.

The REVERSER light comes on for 10 seconds during a T/R stow operation. The light will stay on if the T/R does not stow in 10 seconds. The EAU controls this light.

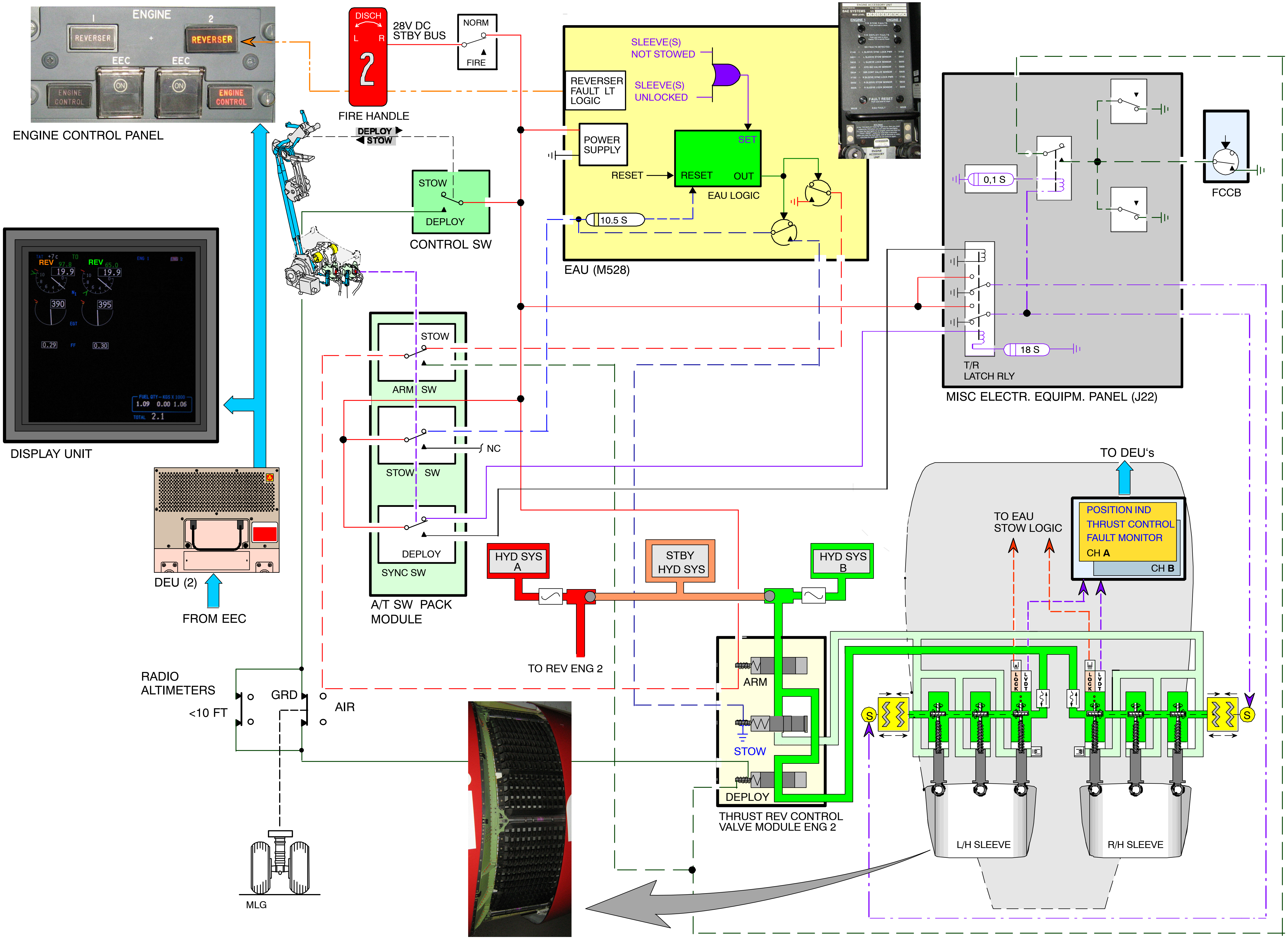


Figure 92 Thrust System Schematic

Reference to Figure 93 Oil System Basic Schematic

ATA 79 ENGINE OIL

79-00 GENERAL

SYSTEM DESCRIPTION

The engine oil system is a self-contained, center vented and recirculating type system.The oil system provide lubrication and cooling for the engine main bearings, radial driveshaft bearings and gears and bearings in the transfer gearbox and accessory GBX.

1 Oil Tank

The oil storage system keeps sufficient oil for a continuous supply to the oil distribution circuit. The oil storage system lets you do an oil level check and to fill the oil system. The engine oil tank holds ~ 20 liters.

2 Anti-leackage Valve

The anti-leakage valve is a pressure-actuated valve. When the engine does not operate, a spring closes the valve. This prevents the oil flow from the oil tank to other oil system components. This also prevents oil leakage during removal of a component of the oil distribution system. When the engine operates, the oil pressure from the supply line holds the valve open.

3 Oil Supply Pump

The accessory gearbox turns the oil supply pump and the three scavenge pumps in the lubrication unit. The pumps are on a common shaft.
The oil supply pump does not control the output pressure. When the engine speed changes, the oil pressure changes.

4 Pressure Relief Valve

The pressure relief valve diverts the oil flow to a scavenge pump, if the pressure downstream of the supply pump exceeds 305 psi.

5 Supply Oil Filter

The supply oil filter removes and holds unwanted material from the supply oil. The supply oil filter prevents the contamination of the downstream oil circuit. When the filter clogs, the supply oil filter bypass valve opens.

6 Oil Pressure/Temp. Sensor

The oil pressure transmitter measures the differential pressure between the oil supply pump outlet and the TGB cavity. The oil pressure transmitter sends an electric signal to the EEC. The EEC send it to the DEUs.

When the oil pressure is less than the red line limit, the EEC sends a signal to the DEUs. This causes the DU to show the amber low oil pressure message.
The oil temperature sensor gets the oil temperature data on the forward sump and TGB oil supply line. The oil temperature sensor sends an electric signal to the EEC. The EEC send it to the DEUs.

7 Scavenge Oil Pump

The scavenge pumps takes the oil that collects in the sumps and the gearboxes and sends it back to the oil tank.

8 Chip Detector

The chip detectors collect and keep the unwanted materials from the scavenge oil. A chip detector has a magnet and a metallic-mesh screen.

9 Debri Monitoring System

The debris monitoring system detects magnetic particles suspended in the scavenge oil and sends a signal through three wires to the DPM box. From the DPM box a single wire transmits the signal to EEC channel B. Then a message "DMS requires inspection" can be retrieved by interrogating the CDU. The are three electrical chip detectors, one for each sump:

- Forward sump.
- Rear sump.
- AGB & TGB sump.

10 Scavenge Oil Filter

The scavenge oil filter removes debris from the three scavenge circuits.

- Accessory gearbox/Transfer gearbox
- FWD sump
- AFT sump

As the scavenge filter becomes clogged, the pressure differential across the switch increases. When it gets >26psig, the switch closes to complete the warning light circuit and the warning light message for the oil filter bypass comes on.

11 Main Oil/Fuel Heat Exchanger

The main oil/fuel heat exchanger uses fuel from the low pressure fuel pump to decrease the temperature of the scavenge oil.

12 Vent System

Vapors from the forward and aft sumps pass through rotating air/oil separators into the mainshaft center vent tube to be vented out the exhaust. The separated oil is returned to the sumps.

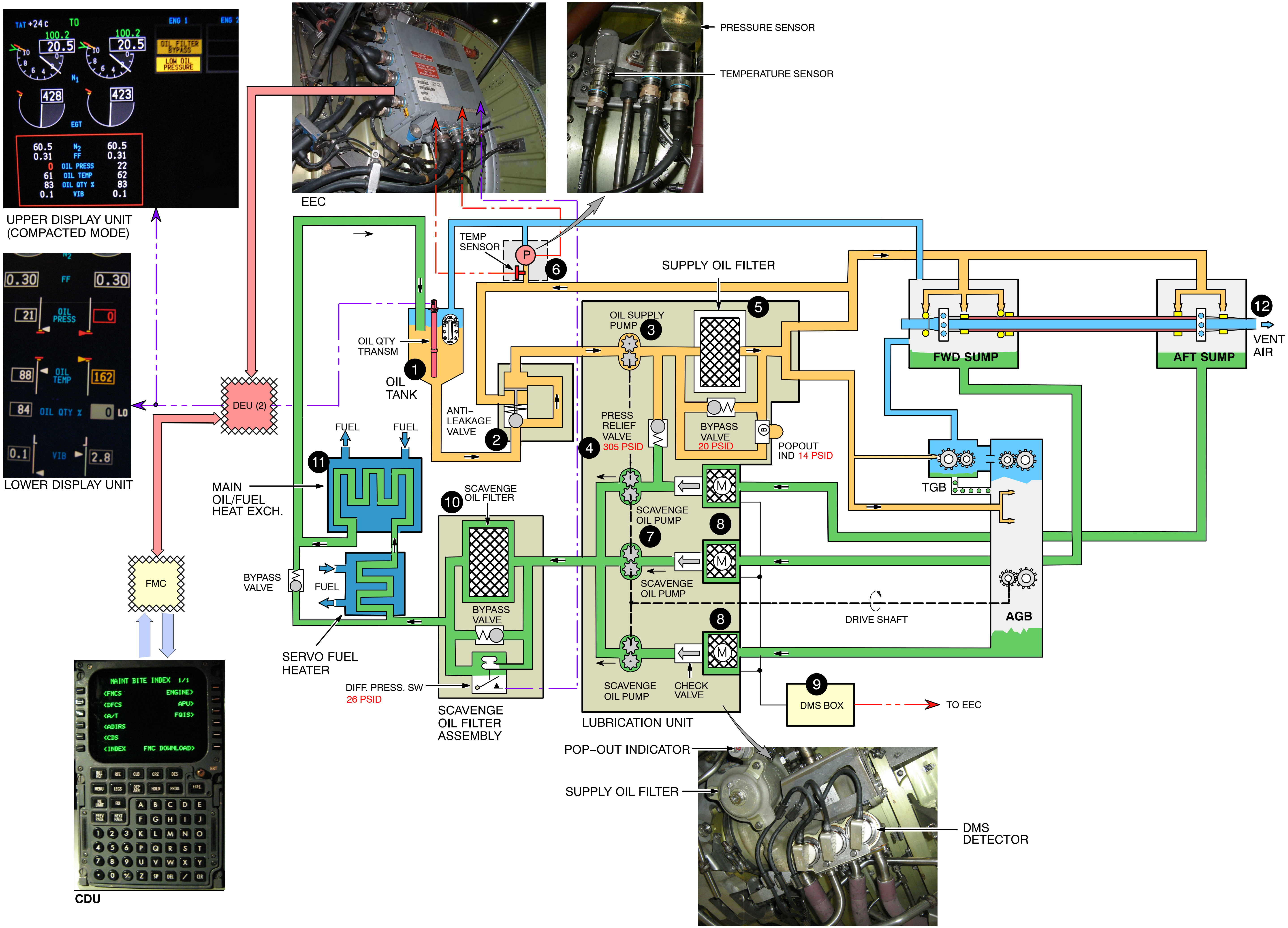


Figure 93 Oil System Basic Schematic

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